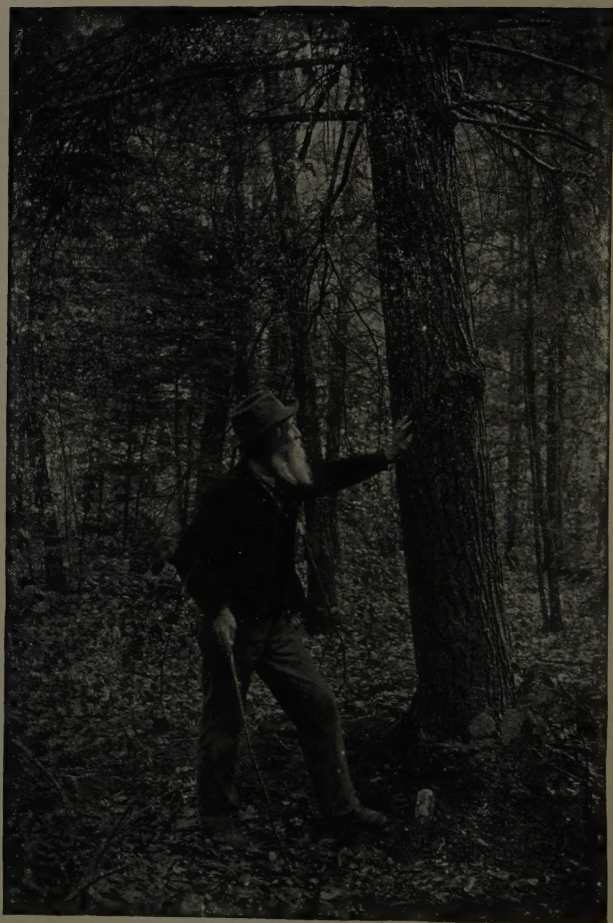




IN THE WOODS

THE
COMPLETE NATURE WRITINGS
of
John Burroughs



THE SUMMIT OF THE YEARS

NEW YORK
WM. H. WISE & COMPANY

THE
COMPLETE NATURAL WRITINGS
OF
John Burroughs

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PREFACE

IN publishing another volume of mixed essays, most of them written in the over-time I have made since I passed the Scriptural limit of three-score and ten years, I am cherishing the hope that my reader will not wish I had stopped at the boundary set by the Psalmist.

There is no other joy in life like mental and bodily activity, like keeping up a live interest in the world of thought and things. Old age is practically held at bay so long as one can keep the currents of his life moving. The vital currents, like mountain streams, tend to rejuvenate themselves as they flow.

One reaps his harvest, and it looks as if his acres would never yield another, but lo! as the seasons return, there springs a fresh crop of ideas and observations. It seems as if one never could get to the end of all the delightful things there are to know, and to observe, and to speculate about in the world. Nature is always young, and there is no greater felicity than to share in her youth. I still find each day too short for all the thoughts I want to think, all the walks I want to take, all the books I want to read, and all the friends I want to see. But I will confide to my reader that there is one thing I am quite cer-

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tain I have got to the end of, and that is the vexed question of the animal mind. Whether the dog, the cat, and the cockroach reason or not, shall trouble me (and them) no more. While I write these lines in my outdoor study, a chipmunk whose den is near by, comes in and eagerly selects the hard, dry kernels of pop-corn from the soft unripe kernels of sweet corn which I have sprinkled upon the floor at my feet, stuffs his cheek pockets with them and hurries away to his den as if he knew that the dry corn would keep in his retreat, and that the green would not. After he has collected all the dry kernels, he falls to eating the green ones. I also sprinkle chokecherries among the corn. These he finally proceeds to strip of their pulp and skins, and stuff his pockets with their pits, and rushes off to his den — thus putting no perishable food in his winter retreat. Does the pretty little rodent reason about all this? Ah! my reader, ask some one else! As for me, I will content myself with his companionship as he runs along my study table, pokes his nose into the arch made by my hand, under which the kernels lie, and even climbs to the crown of my head. He sets me to thinking, and I, if I do not set him to thinking, at least aid him in adding to his winter supplies. We are both learning something; day unto day uttereth knowledge, and even a chipmunk shares a little of the wisdom that pervades the universe.

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I

THE SUMMIT OF THE YEARS

I

THE longer I live the more my mind dwells upon the beauty and the wonder of the world. I hardly know which feeling leads, wonderment or admiration. After a man has passed the psalmist's dead line of seventy years, as Dr. Holmes called it, if he is of a certain temperament, he becomes more and more detached from the noise and turmoil of the times in which he lives. The passing hubbub in the street attracts him less and less; more and more he turns to the permanent, the fundamental, the everlasting. More and more is he impressed with life and nature in themselves, and the beauty and the grandeur of the voyage we are making on this planet. The burning questions and issues of the hour are for the new generations, in whom life also burns intensely.

My life has always been more or less detached from the life about me. I have not been a hermit, but my temperament and love of solitude, and a certain constitutional timidity and shrinking from all kinds of strife, have kept me in the by-paths rather than on the great highways of life. My talent,

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such as it is, is distinctly a by-path talent, or at most, a talent for green lanes and sequestered roadsides; but that which has most interested me in life, nature, can be seen from lanes and by-paths better even than from the turnpike, where the dust and noise and the fast driving obscure the view or distract the attention. I have loved the feel of the grass under my feet, and the sound of the running streams by my side. The hum of the wind in the tree-tops has always been good music to me, and the face of the fields has often comforted me more than the faces of men.

I am in love with this world; by my constitution I have nestled lovingly in it. It has been home. It has been my point of outlook into the universe. I have not bruised myself against it, nor tried to use it ignobly. I have tilled its soil, I have gathered its harvests, I have waited upon its seasons, and always have I reaped what I have sown. While I delved I did not lose sight of the sky overhead. While I gathered its bread and meat for my body, I did not neglect to gather its bread and meat for my soul. I have climbed its mountains, roamed its forests, sailed its waters, crossed its deserts, felt the sting of its frosts, the oppression of its heats, the drench of its rains, the fury of its winds, and always have beauty and joy waited upon my goings and comings.

I have kept apart from the strife and fever of the

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world, and the maelstrom of business and political life, and have sought the paths by the still waters, and in the quiet fields, and life has been sweet and wholesome to me. In my tranquil seclusion I am often on the point of upbraiding myself because I keep so aloof from the struggles and contentions and acrimonious debates of the political, the social, and the industrial world about me. I do not join any of the noisy processions, I do not howl with the reformers, or cry Fire! with the alarmists. I say to myself, What is all this noisy civilization and all this rattling machinery of government for, but that men may all have just the sane and contented life that I am living, and on the same terms that I do. They can find it in the next field, beyond the next hill, in the town or in the country — a land of peace and plenty, if one has peace in his heart and the spirit of fair play in his blood.

Business, politics, government, are but the scaffoldings of our house of life; they are there that I may have a good roof over my head, and a warm and safe outlook into the beauty and glory of the universe, and let them not absorb more time and energy than the home itself. They have absorbed very little of mine, and I fancy that my house of life would have had just as staunch walls, and just as many windows and doors, had they not absorbed so much of other men's. Let those who love turmoil arm for turmoil: their very arming will bring it;

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and let those who love peace disarm for peace: the disarming will hasten it.

I know that all this clamor and competition, all this heat and friction and turmoil of the world, are only the result of the fury with which we play the game of our civilization. It is like our college football, which is brutal and killing, and more like war than like sport. Why should I be more than an amused or a pained spectator?

I was never a fighter; I fear that at times I may have been a shirker, but I have shirked one thing or one duty that I might the more heartily give myself to another. He also serves who sometimes runs away.

From the summit of the years I look back over my life, and see what I have escaped and what I have missed, as a traveler might look back over his course from a mountain-top, and see where he had escaped a jungle or a wilderness or a desert, and where he had missed a fair field or a fountain, or pleasant habitations. I have escaped the soul-killing and body-wrecking occupations that are the fate of so many men in my time. I have escaped the greed of wealth, the "mania of owning things," as Whitman called it. I have escaped the disappointment of political ambition, of business ambition, of social ambition; I have never lost myself in the procession of parties, or trained with any sect or clique. I have been fortunate in being allowed to go

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my own way in the world. I was fortunate in my youth in having escaped the daily paper, and especially the Sunday paper and the comic supplement, and the flood of cheap fiction that now submerges the reading public.

It is a question whether in escaping a college education I made a hit or a miss. I am inclined to the opinion that a little systematic training, especially in science, would have been a gain, though the systematic grind in literature which the college puts its students through I am glad to have escaped. I thank Heaven that in literature I have never had to dissect Shakespeare or Milton, or any other great poet, in the classroom, and that I have never had to dissect any animal in the laboratory. I have had the poets in their beautiful and stimulating unity and wholeness, and I have had the animals in the fields and woods in the joy of their natural activities. In my literary career I have escaped trying to write for the public or for editors; I have written for myself. I have not asked, "What does the public want?" I have only asked, "What do I want to say? What is there in my heart craving for expression? What have I lived or felt or thought that is my own, and has its root in my inmost being?"

I have few of the aptitudes of the scholar, and fewer yet of the methodical habits and industry of the man of business. I live in books a certain part of each day, but less as a student of books than as a

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student of life. I go to books and to nature as a bee goes to the flower, for a nectar that I can make into my own honey. My memory for the facts and the arguments of books is poor, but my absorptive power is great. What I meet in life, in my walks, or in my travels, which is akin to me, or in the line of my interest and sympathies, that sticks to me like a burr, or, better than that, like the food I eat. So with books: what I get from them I do not carry in my memory, but it is absorbed as the air I breathe or the water I drink. It is rarely ready on my tongue or my pen, but makes itself felt in a much more subtle and indirect way.

There is no one, I suppose, who does not miss some good fortune in his life. We all miss congenial people, people who are going our way, and whose companionship would make life sweeter for us. Often we are a day too early, or a day too late, at the point where our paths cross. How many such congenial souls we miss we know not, but for my part, considering the number I have met, I think it may be many.

I have missed certain domestic good fortunes, such as a family of many children (I have only one), which might have made the struggle of life harder, but which would surely have brought its compensations. Those lives are, indeed, narrow and confined which are not blessed with several children. Every branch the tree puts out lays it open more to the

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storms and tempests of life; it lays it open also to the light and the sunshine, and to the singing and the mating birds. A childless life is a tree without branches, a house without windows.

I missed being a soldier in the armies of the Union during the Civil War, which was probably the greatest miss of my life. I think I had in me many of the qualities that go to the making of a good soldier — love of adventure, keenness of eye and ear, love of camp-life, ability to shift for myself, skill with the gun, and a sound constitution. But the rigidity of the military system, the iron rules, the mechanical unity and precision, the loss of the one in the many — all would have galled me terribly, though better men than I willingly, joyously, made themselves a part of the great military machine. I should have made a good scout and skirmisher, but a poor fighter in the ranks. I am a poor fighter, anyhow.

My grandfather was a soldier of the Revolution, and he seems to have used up about all the fighting blood there was in the family, for little of it has shown itself since. When one of his sons was drafted in the War of 1812, he went in his stead, but did not get face to face with the enemy.

I got near enough to the firing line during our Civil War — when Early made his demonstration against the Capital in 1864, and I was a clerk in the Treasury Department — to know that I much prefer the singing of the birds to the singing of

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hostile bullets. Maybe it was a nudge from the Old Continental within me that prompted me to make my way out Seventh Street, flanking and eluding the guards and sentinels of the Sixth Corps just up from Petersburg, taking a roundabout course through fields and woods, till just before dark I found myself amid the rifle-pits in front of one of the forts, fraternizing with the war-worn veterans who had been hurried up from Grant's army.

I had really made myself believe that if there was to be a battle I would have a hand in it and see what it was like. I was unarmed, but the soldiers assured me that they could quickly put a gun in my hand when the enemy appeared. There was some firing in front on a hill a mile away, and now and then I heard the *ping* of a rifle bullet overhead, and a few times the *thud* it makes when it strikes the ground. They were ugly sounds to me, and to the amusement of Grant's veterans who lay about on the ground, as if they were on a picnic, I presently took to the shelter of the rifle-pits and remained there. Later, when I saw a company of soldiers being hurried off into the darkness toward the line of rifle-flashes along the horizon in front, I had a sudden and vivid conviction that the stuff of a good soldier was not in me, — not at that moment, at any rate.

If I had been ordered to join those soldiers and face that unseen and unknown danger out there in

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and water negative, and he interprets the symptoms accordingly. He is keenly alive to all outward impressions. When he descends from the hill in the autumn twilight, he notes the cooler air of the valley like a lake about him; he notes how, at other seasons, the cooler air at times settles down between the mountains like a vast body of water, as shown by the level line of the fog or the frost upon the trees.

The modern man looks at nature with an eye of sympathy and love where the earlier man looked with an eye of fear and superstition. Hence he sees more closely and accurately; science has made his eye steady and clear. To a hasty traveler through the land, the farms and country homes all seem much alike, but to the people born and reared there, what a difference! They have read the fine print that escapes the hurried eye and that is so full of meaning. Every horizon line, every curve in hill or valley, every tree and rock and spring run, every turn in the road and vista in the landscape, has its special features and makes its own impression.

Scott wrote in his journal: "Nothing is so tiresome as walking through some beautiful scene with a minute philosopher, a botanist, or a pebble-gatherer, who is eternally calling your attention from the grand features of the natural picture to look at grasses and chuckie-stanes." No doubt Scott's large, generous way of looking at things

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kindles the imagination and touches the sentiments more than does this minute way of the specialist. The nature that Scott gives us is like the air and the water that all may absorb, while what the specialist gives us is more like some particular element or substance that only the few can appropriate. But Scott had his specialties, too, the specialties of the sportsman; he was the first to see the hare's eyes as she sat in her form, and he knew the ways of grouse and pheasants and trout. The ideal observer turns the enthusiasm of the sportsman into the channels of natural history, and brings home a finer game than ever fell to shot or bullet. He too has an eye for the fox and the rabbit and the migrating water-fowl, but he sees them with loving and not with murderous eyes.

III

So far as seeing things is an art, it is the art of keeping your eyes and ears open. The art of nature is all in the direction of concealment. The birds, the animals, all the wild creatures, for the most part try to elude your observation. The art of the bird is to hide her nest; the art of the game you are in quest of is to make itself invisible. The flower seeks to attract the bee and the moth by its color and perfume, because they are of service to it; but I presume it would hide from the excursionists and the picnickers if it could, because they extirpate it.

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Power of attention and a mind sensitive to outward objects, in these lies the secret of seeing things. Can you bring all your faculties to the front, like a house with many faces at the doors and windows; or do you live retired within yourself, shut up in your own meditations? The thinker puts all the powers of his mind in reflection: the observer puts all the powers of his mind in perception; every faculty is directed outward; the whole mind sees through the eye and hears through the ear. He has an objective turn of mind as opposed to a subjective. A person with the latter turn of mind sees little. If you are occupied with your own thoughts, you may go through a museum of curiosities and observe nothing. .

Of course one's powers of observation may be cultivated as well as anything else. The senses of seeing and hearing may be quickened and trained as well as the sense of touch. Blind persons come to be marvelously acute in their powers of touch. Their feet find the path and keep it. They come to know the lay of the land through this sense, and recognize the roads and surfaces they have once traveled over. Helen Keller reads your speech by putting her hand upon your lips, and is thrilled by the music of an instrument through the same sense of touch. The perceptions of school-children should be trained as well as their powers of reflection and memory. A teacher in Connecticut, Miss Aiken, —

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whose work on mind-training I commend to all teachers, — has hit upon a simple and ingenious method of doing this. She has a revolving black-board upon which she writes various figures, numbers, words, sentences, which she exposes to the view of the class for one or two or three seconds, as the case may be, and then asks them to copy or repeat what was written. In time they become astonishingly quick, especially the girls, and can take in a multitude of things at a glance. Detectives, I am told, are trained after a similar method; a man is led quickly by a show-window, for instance, and asked to name and describe the objects he saw there. Life itself is of course more or less a school of this kind, but the power of concentrated attention in most persons needs stimulating. Here comes in the benefit of manual-training schools. To *do* a thing, to make something, the powers of the mind must be focused. A boy in building a boat will get something that all the books in the world cannot give him. The concrete, the definite, the discipline of real things, the educational values that lie here, are not enough appreciated.

IV

The book of nature is like a page written over or printed upon with different-sized characters and in many different languages, interlined and cross-lined, and with a great variety of marginal notes

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and references. There is coarse print and fine print; there are obscure signs and hieroglyphics. We all read the large type more or less appreciatively, but only the students and lovers of nature read the fine lines and the footnotes. It is a book which he reads best who goes most slowly or even tarries long by the way. He who runs may read some things. We may take in the general features of sky, plain, and river from the express train, but only the pedestrian, the saunterer, with eyes in his head and love in his heart, turns every leaf and peruses every line. One man sees only the migrating water-fowls and the larger birds of the air; another sees the passing kinglets and hurrying warblers as well. For my part, my delight is to linger long over each page of this marvelous record, and to dwell fondly upon its most obscure text.

I take pleasure in noting the minute things about me. I am interested even in the ways of the wild bees, and in all the little dramas and tragedies that occur in field and wood. One June day, in my walk, as I crossed a rather dry, high-lying field, my attention was attracted by small mounds of fresh earth all over the ground, scarcely more than a handful in each. On looking closely, I saw that in the middle of each mound there was a hole not quite so large as a lead-pencil. Now, I had never observed these mounds before, and my curiosity was aroused. "Here is some fine print," I said,

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“that I have overlooked.” So I set to work to try to read it; I waited for a sign of life. Presently I saw here and there a bee hovering about over the mounds. It looked like the honey-bee, only less pronounced in color and manner. One of them alighted on one of the mounds near me, and was about to disappear in the hole in the centre when I caught it in my hand. Though it stung me, I retained it and looked it over, and in the process was stung several times; but the pain was slight. I saw it was one of our native wild bees, cousin to the leaf-rollers, that build their nests under stones and in decayed fence-rails. (In Packard I found it described under the name of *Andrena*.) Then I inserted a small weed-stalk into one of the holes, and, with a little trowel I carried, proceeded to dig out the nest. The hole was about a foot deep; at the bottom of it I found a little semi-transparent, membranous sac or cell, a little larger than that of the honey-bee; in this sac was a little pellet of yellow pollen — a loaf of bread for the young grub when the egg should have hatched. I explored other nests and found them all the same. This discovery was not a great addition to my sum of natural knowledge, but it was something. Now when I see the signs in a field, I know what they mean: they indicate the tiny earthen cradles of *Andrena*.

Near by I chanced to spy a large hole in the turf, with no mound of soil about it. I could put the end

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of my little finger into it. I peered down, and saw the gleam of two small, bead-like eyes. I knew it to be the den of the wolf-spider. Was she waiting for some blundering insect to tumble in? I say she, because the real ogre among the spiders is the female. The male is small and of little consequence. A few days later I paused by this den again and saw the members of the ogress scattered about her own door. Had some insect Jack the Giant-Killer been there, or had a still more formidable ogress, the sand-hornet, dragged her forth and carried away her limbless body to her den in the bank?

What the wolf-spider does with the earth it excavates in making its den is a mystery. There is no sign of it anywhere about. Does it force its way down by pushing the soil to one side and packing it there firmly? The entrance to the hole usually has a slight rim or hem to keep the edge from crumbling in.

As it happened, I chanced upon another interesting footnote that very day. I was on my way to a muck swamp in the woods, to see if the showy lady's-slipper was in bloom. Just on the margin of the swamp, in the deep shade of the hemlocks, my eye took note of some small, unshapely creature crawling hurriedly over the ground. I stooped down, and saw it was some large species of moth just out of its case, and in a great hurry to find a suitable place in which to hang itself up and give

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its wings a chance to unfold before the air dried them. I thrust a small twig in its way, which it instantly seized upon. I lifted it gently, carried it to drier ground, and fixed the stick in the fork of a tree, so that the moth hung free a few feet from the ground. Its body was distended nearly to the size of one's little finger, and surmounted by wings that were so crumpled and stubby that they seemed quite rudimentary. The creature evidently knew what it wanted, and knew the importance of haste. Instantly these rude, stubby wings began to grow. It was a slow process, but one could see the change from minute to minute. As the wings expanded, the body contracted. By some kind of pumping arrangement air was being forced from a reservoir in the one into the tubes of the other. The wings were not really growing, as they at first seemed to be, but they were unfolding and expanding under this pneumatic pressure from the body. In the course of about half an hour the process was completed, and the winged creature hung there in all its full-fledged beauty. Its color was checked black and white like a loon's back, but its name I know not. My chief interest in it, aside from the interest we feel in any new form of life, arose from the creature's extreme anxiety to reach a perch where it could unfold its wings. A little delay would doubtless have been fatal to it. I wonder how many human geniuses are hatched whose wings are blighted

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by some accident or untoward circumstance. Or do the wings of genius always unfold, no matter what the environment may be?

One seldom takes a walk without encountering some of this fine print on nature's page. Now it is a little yellowish-white moth that spreads itself upon the middle of a leaf as if to imitate the droppings of birds; or it is the young cicadas working up out of the ground, and in the damp, cool places building little chimneys or tubes above the surface to get more warmth and hasten their development; or it is a wood-newt gorging a tree-cricket, or a small snake gorging the newt, or a bird song with some striking peculiarity — a strange defect, or a rare excellence. Now it is a shrike impaling his victim, or blue jays mocking and teasing a hawk and dropping quickly into the branches to avoid his angry blows, or a robin hustling a cuckoo out of the tree where her nest is, or a vireo driving away a cowbird, or the partridge blustering about your feet till her young are hidden. One October morning I was walking along the road on the edge of the woods, when I came into a gentle shower of butternuts; one of them struck my hat-brim. I paused and looked about me; here one fell, there another, yonder a third. There was no wind blowing, and I wondered what was loosening the butternuts. Turning my attention to the top of the tree, I soon saw the explanation: a red squirrel was at work

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gathering his harvest. He would seize a nut, give it a twist, when down it would come; then he would dart to another and another. Farther along I found where he had covered the ground with chestnut burs; he could not wait for the frost and the winds; did he know that the burs would dry and open upon the ground, and that the bitter covering of the butternuts would soon fall away from the nut?

There are three things that perhaps happen near me each season that I have never yet seen — the toad casting its skin, the snake swallowing its young, and the larvæ of the moth and butterfly constructing their shrouds. It is a mooted question whether or not the snake does swallow its young, but if there is no other good reason for it, may they not retreat into their mother's stomach to feed? How else are they to be nourished? That the moth larva can weave its own cocoon and attach it to a twig seems more incredible. Yesterday, in my walk, I found a firm, silver-gray cocoon, about two inches long and shaped like an Egyptian mummy (probably *Promethea*), suspended from a branch of a bush by a narrow, stout ribbon twice as long as itself. The fastening was woven around the limb, upon which it turned as if it grew there. I would have given something to have seen the creature perform this feat, and then incase itself so snugly in the silken shroud at the end of this tether. By swinging free, its firm, compact case was in no danger from

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woodpeckers, as it might have been if resting directly upon a branch or tree-trunk. Near by was the cocoon of another species (*Cecropia*) that was fastened directly to the limb; but this was vague, loose, and much more involved and net-like. I have seen the downy woodpecker assaulting one of these cocoons, but its yielding surface and webby interior seemed to puzzle and baffle him.

I am interested even in the way each climbing plant or vine goes up the pole, whether from right to left, or from left to right, — that is, with the hands of a clock or against them, — whether it is under the law of the great cyclonic storms of the northern hemisphere, which all move against the hands of a clock, or in the contrary direction, like the cyclones in the southern hemisphere. I take pleasure in noting every little dancing whirlwind of a summer day that catches up the dust or the leaves before me, and every little funnel-shaped whirlpool in the swollen stream or river, whether or not they spin from right to left or the reverse. If I were in the southern hemisphere, I am sure I should note whether these things were under the law of its cyclones in this respect or under the law of ours. As a rule, our twining plants and toy whirlwinds copy our revolving storms and go against the hands of the clock. But there are exceptions. While the bean, the bittersweet, the morning-glory, and others go up from left to right, the

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hop, the wild buckwheat, and some others go up from right to left. Most of our forest trees show a tendency to wind one way or the other, the hard woods going in one direction, and the hemlocks and pines and cedars and butternuts and chestnuts in another. In different localities, or on different geological formations, I find these directions reversed. I recall one instance in the case of a hemlock six or seven inches in diameter, where this tendency to twist had come out of the grain, as it were, and shaped the outward form of the tree, causing it to make, in an ascent of about thirty feet, one complete revolution about a larger tree close to which it grew. On a smaller scale I have seen the same thing in a pine.

Persons lost in the woods or on the plains, or traveling at night, tend, I believe, toward the left. The movements of men and women, it is said, differ in this respect, one sex turning to the right and the other to the left.

I had lived in the world more than fifty years before I noticed a peculiarity about the rays of light one often sees diverging from an opening, or a series of openings, in the clouds, namely, that they are like spokes in a wheel, the hub, or centre, of which appears to be just there in the vapory masses, instead of being, as is really the case, nearly ninety-three millions of miles beyond. The beams of light that come through cracks or chinks in a wall do not

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converge in this way, but to the eye run parallel to one another. There is another fact: this fan-shaped display of converging rays is always immediately in front of the observer; that is, exactly between him and the sun, so that the central spoke or shaft in his front is always perpendicular. You cannot see this fan to the right or left of the sun, but only between you and it. Hence, as in the case of the rainbow, no two persons see exactly the same rays.

The eye sees what it has the means of seeing, and its means of seeing are in proportion to the love and desire behind it. The eye is informed and sharpened by the thought. My boy sees ducks on the river where and when I cannot, because at certain seasons he thinks ducks and dreams ducks. One season my neighbor asked me if the bees had injured my grapes. I said, "No; the bees never injure my grapes."

"They do mine," he replied; "they puncture the skin for the juice, and at times the clusters are covered with them."

"No," I said, "it is not the bees that puncture the skin; it is the birds."

"What birds?"

"The orioles."

"But I have n't seen any orioles," he rejoined.

"We have," I continued, "because at this season we think orioles; we have learned by experience

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how destructive these birds are in the vineyard, and we are on the lookout for them; our eyes and ears are ready for them."

If we think birds, we shall see birds wherever we go; if we think arrowheads, as Thoreau did, we shall pick up arrowheads in every field. Some people have an eye for four-leaved clovers; they see them as they walk hastily over the turf, for they already have them in their eyes. I once took a walk with the late Professor Eaton of Yale. He was just then specially interested in the mosses, and he found them, all kinds, everywhere. I can see him yet, every few minutes upon his knees, adjusting his eye-glasses before some rare specimen. The beauty he found in them, and pointed out to me, kindled my enthusiasm also. I once spent a summer day at the mountain home of a well-known literary woman and editor. She lamented the absence of birds about her house. I named a half-dozen or more I had heard or seen in her trees within an hour—the indigo-bird, the purple finch, the yellowbird, the veery thrush, the red-eyed vireo, the song sparrow.

"Do you mean to say you have seen or heard all these birds while sitting here on my porch?" she inquired.

"I really have," I said.

"I do not see them or hear them," she replied, "and yet I want to very much."

THE ART OF SEEING THINGS

"No," said I; "you only *want to want* to see and hear them."

You must have the bird in your heart before you can find it in the bush.

I was sitting in front of a farmhouse one day in company with the local Nimrod. In a maple tree in front of us I saw the great crested flycatcher. I called the hunter's attention to it, and asked him if he had ever seen that bird before. No, he had not; it was a new bird to him. But he probably had seen it scores of times, — seen it without regarding it. It was not the game he was in quest of, and his eye heeded it not.

Human and artificial sounds and objects thrust themselves upon us; they are within our sphere, so to speak: but the life of nature we must meet half-way; it is shy, withdrawn, and blends itself with a vast neutral background. We must be initiated; it is an order the secrets of which are well guarded.

II

THE COMING OF SUMMER

WHO shall say when one season ends and another begins? Only the almanac-makers can fix these dates. It is like saying when babyhood ends and childhood begins, or when childhood ends and youth begins. To me spring begins when the catkins on the alders and the pussy-willows begin to swell; when the ice breaks up on the river and the first sea-gulls come prospecting northward. Whatever the date—the first or the middle or the last of March—when these signs appear, then I know spring is at hand. Her first birds—the bluebird, the song sparrow, the robin, the red-shouldered starling—are here or soon will be. The crows have a more confident caw, the sap begins to start in the sugar maple, the tiny boom of the first bee is heard, the downy woodpecker begins his resonant *tat, tat, tat*, on the dry limbs, and the cattle in the barnyard low long and loud with wistful looks toward the fields.

The first hint of summer comes when the trees are fully fledged and the nymph Shadow is born. See her cool circles again beneath the trees in the

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field, or her deeper and cooler retreats in the woods. On the slopes, on the opposite side of the river, there have been for months under the morning and noon sun only slight shadow tracings, a fretwork of shadow lines; but some morning in May I look across and see solid masses of shade falling from the trees athwart the sloping turf. How the eye revels in them! The trees are again clothed and in their right minds; myriad leaves rustle in promise of the coming festival. Now the trees are sentient beings; they have thoughts and fancies; they stir with emotion; they converse together; they whisper or dream in the twilight; they struggle and wrestle with the storm.

“Caught and cuff’d by the gale,”

Tennyson says.

Summer always comes in the person of June, with a bunch of daisies on her breast and clover blossoms in her hands. A new chapter in the season is opened when these flowers appear. One says to himself, “Well, I have lived to see the daisies again and to smell the red clover.” One plucks the first blossoms tenderly and caressingly. What memories are stirred in the mind by the fragrance of the one and the youthful face of the other! There is nothing else like that smell of the clover: it is the maidenly breath of summer; it suggests all fresh, buxom, rural things. A field of ruddy, blooming clover,

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dashed or sprinkled here and there with the snow-white of the daisies; its breath drifts into the road when you are passing; you hear the boom of bees, the voice of bobolinks, the twitter of swallows, the whistle of woodchucks; you smell wild strawberries; you see the cattle upon the hills; you see your youth, the youth of a happy farm-boy, rise before you. In Kentucky I once saw two fields, of one hundred acres each, all ruddy with blooming clover — perfume for a whole county.

The blooming orchards are the glory of May, the blooming clover-fields the distinction of June. Other characteristic June perfumes come from the honey-locusts and the blooming grapevines. At times and in certain localities the air at night and morning is heavy with the breath of the former, and along the lanes and roadsides we inhale the delicate fragrance of the wild grape. The early grasses, too, with their frostlike bloom, contribute something very welcome to the breath of June.

Nearly every season I note what I call the bridal day of summer — a white, lucid, shining day, with a delicate veil of mist softening all outlines. How the river dances and sparkles; how the new leaves of all the trees shine under the sun; the air has a soft lustre; there is a haze, it is not blue, but a kind of shining, diffused nimbus. No clouds, the sky a bluish white, very soft and delicate. It is the nuptial day of the season; the sun fairly takes the earth to

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be his own, for better or for worse, on such a day, and what marriages there are going on all about us: the marriages of the flowers, of the bees, of the birds. Everything suggests life, love, fruition. These bridal days are often repeated; the serenity and equipoise of the elements combine. They were such days as these that the poet Lowell had in mind when he exclaimed, "What is so rare as a day in June?" Here is the record of such a day, June 1, 1883: "Day perfect in temper, in mood, in everything. Foliage all out except on button-balls and celtis, and putting on its dark green summer color, solid shadows under the trees, and stretching down the slopes. A few indolent summer clouds here and there. A day of gently rustling and curtsying leaves, when the breeze almost seems to blow upward. The fields of full-grown, nodding rye slowly stir and sway like vast assemblages of people. How the chimney swallows chipper as they sweep past! The vireo's cheerful warble echoes in the leafy maples; the branches of the Norway spruce and the hemlocks have gotten themselves new light green tips; the dandelion's spheres of ethereal down rise above the grass: and now and then one of them suddenly goes down: the little chippy, or social sparrow, has thrown itself upon the frail stalk and brought it to the ground, to feed upon its seeds; here it gets the first fruits of the season. The first red and white clover heads have just opened, the

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yellow rock-rose and the sweet viburnum are in bloom; the bird chorus is still full and animated; the keys of the red maple strew the ground, and the cotton of the early everlasting drifts upon the air." For several days there was but little change. "Getting toward the high tide of summer. The air well warmed up, Nature in her jocund mood, still, all leaf and sap. The days are idyllic. I lie on my back on the grass in the shade of the house, and look up to the soft, slowly moving clouds, and to the chimney swallows disporting themselves up there in the breezy depths. No hardening in vegetation yet. The moist, hot, fragrant breath of the fields — mingled odor of blossoming grasses, clover, daisies, rye — the locust blossoms, dropping. What a humming about the hives; what freshness in the shade of every tree; what contentment in the flocks and herds! The springs are yet full and cold; the shaded watercourses and pond margins begin to draw one." Go to the top of the hill on such a morning, say by nine o'clock, and see how unspeakably fresh and full the world looks. The morning shadows yet linger everywhere, even in the sunshine; a kind of blue coolness and freshness, the vapor of dew tinting the air.

Heat and moisture, the father and mother of all that lives, when June has plenty of these, the increase is sure.

Early in June the rye and wheat heads begin to

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nod; the motionless stalks have a reflective, meditative air. A little while ago, when their heads were empty or filled only with chaff and sap, how straight up they held them! Now that the grain is forming, they have a sober, thoughtful look. It is one of the most pleasing spectacles of June, a field of rye gently shaken by the wind. How the breezes are defined upon its surface — a surface as sensitive as that of water; how they trip along, little breezes and big breezes together! Just as this glaucous green surface of the rye-field bends beneath the light tread of the winds, so, we are told, the crust of the earth itself bends beneath the giant strides of the great atmospheric waves.

There is one bird I seldom hear till June, and that is the cuckoo. Sometimes the last days of May bring him, but oftener it is June before I hear his note. The cuckoo is the true recluse among our birds. I doubt if there is any joy in his soul. "Rain-crow," he is called in some parts of the country. His call is supposed to bode rain. Why do other birds, the robin for instance, often make war upon the cuckoo, chasing it from the vicinity of their nests? There seems to be something about the cuckoo that makes its position among the birds rather anomalous. Is it at times a parasitical bird, dropping its eggs into other birds' nests? Or is there some suggestion of the hawk about our species as well as about the European? I do not know. I

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only know that it seems to be regarded with a suspicious eye by other birds, and that it wanders about at night in a way that no respectable bird should. The birds that come in March, as the bluebird, the robin, the song sparrow, the starling, build in April; the April birds, such as the brown thrasher, the barn swallow, the chewink, the water-thrush, the oven-bird, the chippy, the high-hole, the meadowlark, build in May, while the May birds, the kingbird, the wood thrush, the oriole, the orchard starling, and the warblers, build in June. The April nests are exposed to the most dangers: the storms, the crows, the squirrels, are all liable to cut them off. The midsummer nests, like that of the goldfinch and the waxwing, or cedar-bird, are the safest of all.

In March the door of the seasons first stands ajar a little; in April it is opened much wider; in May the windows go up also; and in June the walls are fairly taken down and the genial currents have free play everywhere. The event of March in the country is the first good sap day, when the maples thrill with the kindling warmth; the event of April is the new furrow and the first seeding; — how ruddy and warm the soil looks just opened to the sun! — the event of May is the week of orchard bloom; with what sweet, pensive gladness one walks beneath the pink-white masses, while long, long thoughts descend upon him! See the impetuous orioles chase

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one another amid the branches, shaking down the fragrant snow. Here the rose-breasted grosbeak is in the blooming cherry tree, snipping off the blossoms with that heavy beak of his — a spot of crimson and black half hidden in masses of white petals. This orchard bloom travels like a wave. In March it is in the Carolinas; by the middle of April its crest has reached the Potomac; a week or ten days later it is in New Jersey; then in May it sweeps through New York and New England; and early in June it is breaking upon the orchards in Canada. Finally, the event of June is the fields ruddy with clover and milk-white with daisies.

III

A BREATH OF APRIL

I

IT would not be easy to say which is our finest or most beautiful wild flower, but certainly the most poetic and the best beloved is the arbutus. So early, so lowly, so secretive there in the moss and dry leaves, so fragrant, tinged with the hues of youth and health, so hardy and homelike, it touches the heart as no other does.

April's flower offers the first honey to the bee and the first fragrance to the breeze. Modest, exquisite, loving the evergreens, loving the rocks, untamable, it is the very spirit and breath of the woods. Trailing, creeping over the ground, hiding its beauty under withered leaves, stiff and hard in foliage, but in flower like the cheek of a maiden.

One may brush away the April snow and find this finer snow beneath it. Oh, the arbutus days, what memories and longings they awaken! In this latitude they can hardly be looked for before April, and some seasons not till the latter days of the month. The first real warmth, the first tender skies, the first fragrant showers — the woods are

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flooded with sunlight, and the dry leaves and the leaf-mould emit a pleasant odor. One kneels down or lies down beside a patch of the trailing vine, he brushes away the leaves, he lifts up the blossoming sprays and examines and admires them at leisure; some are white, some are white and pink, a few are deep pink. It is enough to bask there in the sunlight on the ground beside them, drinking in their odor, feasting the eye on their tints and forms, hearing the April breezes sigh and murmur in the pines or hemlocks near you, living in a present fragrant with the memory of other days. Lying there, half dreaming, half observing, if you are not in communion with the very soul of spring, then there is a want of soul in you. You may hear the first swallow twittering from the sky above you, or the first mellow drum of the grouse come up from the woods below or from the ridge opposite. The bee is abroad in the air, finding her first honey in the flower by your side and her first pollen in the pussy-willows by the watercourses below you. The tender, plaintive love-note of the chickadee is heard here and there in the woods. He utters it while busy on the catkins of the poplars, from which he seems to be extracting some kind of food. Hawks are screaming high in the air above the woods; the plow is just tasting the first earth in the rye or corn stubble (and it tastes good). The earth looks good, it smells good, it is good. By the creek in the woods you hear the

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first water-thrush — a short, bright, ringing, hurried song. If you approach, the bird flies swiftly up or down the creek, uttering an emphatic “chip, chip.”

In wild, delicate beauty we have flowers that far surpass the arbutus: the columbine, for instance, jetting out of a seam in a gray ledge of rock, its many crimson and flame-colored flowers shaking in the breeze; but it is mostly for the eye. The spring-beauty, the painted trillium, the fringed polygala, the showy lady's-slipper, are all more striking to look upon, but they do not quite touch the heart; they lack the soul that perfume suggests. Their charms do not abide with you as do those of the arbutus.

II

These still, hazy, brooding mid-April mornings, when the farmer first starts afield with his plow, when his boys gather the buckets in the sugar-bush, when the high-hole calls long and loud through the hazy distance, when the meadowlark sends up her clear, silvery shaft of sound from the meadow, when the bush sparrow trills in the orchard, when the soft maples look red against the wood, or their fallen bloom flecks the drying mud in the road, — such mornings are about the most exciting and suggestive of the whole year. How good the fields look, how good the freshly turned earth looks! — one could almost eat it as does the horse; — the stable manure just being drawn out and scattered

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looks good and smells good; every farmer's house and barn looks inviting; the children on the way to school with their dinner-pails in their hands — how they open a door into the past for you! Sometimes they have sprays of arbutus in their button-holes, or bunches of hepatica. The partridge is drumming in the woods, and the woodpeckers are drumming on dry limbs.

The day is veiled, but we catch such glimpses through the veil. The bees are getting pollen from the pussy-willows and soft maples, and the first honey from the arbutus.

It is at this time that the fruit and seed catalogues are interesting reading, and that the cuts of farm implements have a new fascination. The soil calls to one. All over the country, people are responding to the call, and are buying farms and moving upon them. My father and mother moved upon their farm in the spring of 1828; I moved here upon mine in March, 1874.

I see the farmers, now going along their stone fences and replacing the stones that the frost or the sheep and cattle have thrown off, and here and there laying up a bit of wall that has tumbled down.

There is rare music now in the unmusical call of the phoebe-bird — it is so suggestive.

The drying road appeals to one as it never does at any other season. When I was a farm-boy, it was about this time that I used to get out of my

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boots for half an hour and let my bare feet feel the ground beneath them once more. There was a smooth, dry, level place in the road near home, and along this I used to run, and exult in that sense of lightfootedness which is so keen at such times. What a feeling of freedom, of emancipation, and of joy in the returning spring I used to experience in those warm April twilights!

I think every man whose youth was spent on the farm, whatever his life since, must have moments at this season when he longs to go back to the soil. How its sounds, its odors, its occupations, its associations, come back to him! Would he not like to return again to help rake up the litter of straw and stalks about the barn, or about the stack on the hill where the grass is starting? Would he not like to help pick the stone from the meadow, or mend the brush fence on the mountain where the sheep roam, or hunt up old Brindle's calf in the woods, or gather oven-wood for his mother to start again the big brick oven with its dozen loaves of rye bread, or see the plow crowding the lingering snow-banks on the side-hill, or help his father break and swingle and hatchel the flax in the barnyard?

When I see a farm advertised for rent or for sale in the spring, I want to go at once and look it over. All the particulars interest me — so many acres of meadow-land, so many of woodland, so many of pasture — the garden, the orchard, the outbuild-

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ings, the springs, the creek — I see them all, and am already half in possession.

Even Thoreau felt this attraction, and recorded in his Journal: "I know of no more pleasing employment than to ride about the country with a companion very early in the spring, looking at farms with a view to purchasing, if not paying for them."

Blessed is the man who loves the soil!

III

One mid-April morning two pairs of bluebirds were in very active and at times violent courtship about my grounds. I could not quite understand the meaning of all the fuss and flutter. Both birds of each pair were very demonstrative, but the female in each case the more so. She followed the male everywhere, lifting and twinkling her wings, and apparently seeking to win him by both word and gesture. If she was not telling him by that cheery, animated, confiding, softly-endearing speech of hers, which she poured out incessantly, how much she loved him, what was she saying? She was constantly filled with a desire to perch upon the precise spot where he was sitting, and if he had not moved away, I think she would have alighted upon his back. Now and then, when she flitted away from him, he followed her with like gestures and tones and demonstrations of affection, but never with

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quite the same ardor. The two pairs kept near each other about the house, the bird-boxes, the trees, the posts and vines in the vineyard, filling the ear with their soft, insistent warbles, and the eye with their twinkling azure wings.

Was it this constant presence of rivals on both sides that so stimulated them and kept them up to such a pitch of courtship? Finally, after I had watched them over an hour, the birds began to come into collision. As they met in the vineyard, the two males clinched and fell to the ground, lying there for a moment with wings sprawled out, like birds brought down by a gun. Then they separated, and each returned to his mate, warbling and twinkling his wings. Very soon the females clinched and fell to the ground and fought savagely, rolling over and over each other, clawing and tweaking and locking beaks and hanging on like bull terriers. They did this repeatedly; once one of the males dashed in and separated them, by giving one of the females a sharp tweak and blow. Then the males were at it again, their blue plumage mixing with the green grass and ruffled by the ruddy soil. What a soft, feathery, ineffectual battle it seemed in both cases; no sound, no blood, no flying feathers, just a sudden mixing up and general disarray of blue wings and tails and ruddy breasts, there on the ground; assault but no visible wounds; thrust of beak and grip of claw, but no feather

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loosened and but little ruffling; long holding of one down by the other, but no cry of pain or fury. It was the kind of battle that one likes to witness. The birds usually locked beaks, and held their grip half a minute at a time. One of the females would always alight by the struggling males and lift her wings and utter her soft notes, but what she said — whether she was encouraging one of the blue coats or berating the other, or imploring them both to desist, or egging them on — I could not tell. So far as I could understand her speech, it was the same as she had been uttering to her mate all the time.

The language of birds is so limited that one cannot always tell their love-calls from their battle-cries. I recognize three notes in the bluebird — a simple, plaintive call uttered in the air by the migrating birds, both fall and spring, which is like the word “pure,” “pure;” then the animated warbling calls and twitterings, during the mating season, which are uttered in a fond, reassuring tone, usually accompanied by that pretty wing gesture; then the call of alarm when some enemy approaches the nest or a hawk appears.

This last note is soft like the others, but the tone is different; it is sorrowful and apprehensive. Most of our song birds have these three notes expressive of love, alarm, and fellowship. The last-named call seems to keep them in touch with one another. I might perhaps add to this list the scream of distress

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which most birds utter when caught by a cat or a hawk — the voice of uncontrolled terror and pain, which is nearly the same in all species — dissonant and piercing. The other notes and calls are characteristic, but this last is the simple screech of common terrified nature.

When my bluebirds dashed at each other with beak and claw, their preliminary utterances had to my ears anything but a hostile sound. Indeed, for the bluebird to make a harsh, discordant sound seems out of the question. Once, when the two males lay upon the ground with outspread wings and locked beaks, a robin flew down by them and for a moment gazed intently at the blue splash upon the grass, and then went his way.

As the birds drifted about the grounds, first the males, then the females rolling on the grass or in the dust in fierce combat, and between times the members of each pair assuring each other of undying interest and attachment, I followed them, apparently quite unnoticed by them. Sometimes they would lie more than a minute upon the ground, each trying to keep his own or to break the other's hold. They seemed so oblivious of everything about them that I wondered if they might not at such times fall an easy prey to cats and hawks. Let me put their watchfulness to the test, I said. So, as the two males clinched again and fell to the ground, I cautiously approached them, hat in hand. When

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ten feet away and unregarded, I made a sudden dash and covered them with my hat. The struggle continued for a few seconds under there, then all was still. Sudden darkness had fallen upon the field of battle. What did they think had happened? Presently their heads and wings began to brush the inside of my hat. Then all was still again. Then I spoke to them, called to them, exulted over them, but they betrayed no excitement or alarm. Occasionally a head or a body came in gentle contact with the top or the sides of my hat.

But the two females were evidently agitated by the sudden disappearance of their contending lovers, and began uttering their mournful alarm-note. After a minute or two I lifted one side of my hat and out darted one of the birds; then I lifted the hat from the other. One of the females then rushed, apparently with notes of joy and congratulation, to one of the males, who gave her a spiteful tweak and blow. Then the other came and he served her the same. He was evidently a little bewildered, and not certain what had happened or who was responsible for it. Did he think the two females were in some way to blame? But he was soon reconciled to one of them again, as was the other male with the other, yet the two couples did not separate till the males had come in collision once more. Presently, however, they drifted apart, and each pair was soon holding an animated con-

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versation, punctuated by those pretty wing gestures, about the two bird-boxes.

These scenes of love and rivalry had lasted nearly all the forenoon, and matters between the birds apparently remained as they were before — the members of each pair quite satisfied with each other. One pair occupied one of the bird-boxes in the vineyard and reared two broods there during the season, but the other pair drifted away and took up their abode somewhere else.

If they had come to an understanding, why this continued demonstration and this war between them? The unusual thing was the interest and the activity of the females. They outdid the males in making love and in making war. With most species of our birds, the females are quite indifferent to the blandishments of the males, if they are not actually bored by them. They flee from them, or spitefully resent their advances. In April a female robin may often be seen fighting off three or four of her obstreperous admirers, as if every feminine sentiment she possessed had been outraged.

But the bluebird is an exception; the female is usually very responsive, but only in the instance above related have I seen her so active in the courtship.

IV

A WALK IN THE FIELDS

LET us go and walk in the fields. It is the middle of a very early March — a March that has in some way cut out April and got into its place.

I knew an Irish laborer, who during his last illness thought, when spring came, if he could walk in the fields, he would get well. I have observed that farmers, when harassed by trouble, or weighed down by grief, are often wont to go and walk alone in the fields. They find dumb sympathy and companionship there. I knew a farmer who, after the death of his only son, would frequently get up in the middle of the night and go and walk in his fields. It was said that he had been harsh and unjust to his son, and, during the last day the latter had worked and when the fatal illness was coming upon him, the father had severely upbraided him because he left his task and sat for a while under the fence. One can fancy him going to this very spot in his midnight wanderings, and standing in mute agony where the cruel words had been spoken, or throwing himself upon the ground, pleading in vain at the door of the irrevocable past. That door

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never opens again, plead you there till your heart breaks.

A farmer's fields become in time almost a part of himself: his life history is written all over them; virtue has gone out of himself into them; he has fertilized them with the sweat of his brow; he knows the look and the quality of each one. This one he reclaimed from the wilderness when he came on the farm as a young man; he sowed rye among the stumps and scratched it in with a thorn brush; as the years went by he saw the stumps slowly decay; he would send his boys to set fire to them in the dry spring weather; — I was one of those boys, and it seems as if I could smell the pungent odor of those burning stumps at this moment: now this field is one of his smoothest, finest meadows. This one was once a rough pasture; he pried up or blasted out the rocks, and with his oxen drew them into a line along the border of the woods, and with stone picked or dug from the surface built upon them a solid four-foot wall; now the mowing-machine runs evenly where once the cattle grazed with difficulty.

I was a boy when that field was cleaned up. I took a hand — a boy's hand — in the work. I helped pick up the loose stone, which we drew upon a stone-boat shod with green poles. It was back-aching work, and it soon wore the skin thin on the ends of the fingers. How the crickets and ants and beetles would rush about when we uncovered them! They no doubt

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looked upon the stone that sheltered them as an old institution that we had no right to remove. No right, my little folk, only the might of the stronger. Sometimes a flat stone would prove the roof of a mouse-nest — a blinking, bead-eyed, meadow-mouse. What consternation would seize him, too, as he would rush off along the little round beaten ways under the dry grass and weeds! Many of the large bowlders were deeply imbedded in the soil, and only stuck their noses or heads, so to speak, up through the turf. These we would first tackle with the big lever, a long, dry, ironwood pole, as heavy as one could handle, shod with a horseshoe. With the end of this thrust under the end or edge of a bowlder, and resting upon a stone for a fulcrum, we would begin the assault. Inch by inch the turf-bound rock would yield. Sometimes the lever would slip its hold, and come down upon our heads if we were not watchful. As the rock yielded, the lever required more bait, as the farmer calls it, — an addition to the fulcrum. After the rock was raised sufficiently, we would prop it up with stones, arrange a skid or skids under it — green beech poles cut in the woods — wrap a chain around it, and hitch the oxen to it, directing them to the right or left to turn the bowlder out of its bed and place it on the surface of the ground. When this was accomplished, then came the dead straight pull to the line of the fence. An old, experienced ox-team know what is before them, or

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rather behind them; they have felt the bowlder and sized it up. At the word and the crack of the whip they bend their heads and throw their weight upon the yoke. Now the hickory bows settle into their shoulders, they kink their tails and hump their backs, their sharp hoofs cut the turf, and the great inert mass moves. Tearing up the sod, grinding over stones, the shouts of the excited driver urging them on, away they go toward the line. The peculiar and agreeable odor of burnt and ground stone arises from the rear. Only a few yards at a time; how the oxen puff as they halt to take breath and lap their tongues out over their moist muzzles! Then they bend to the work again, the muscular effort reaching their very tails. Thus the work goes on for several days or a week, till the row of bottom rocks is complete. If there are others remaining in the field, then the row is doubled up till the land is cleaned.

What a torn and wounded appearance that section of ground presents, its surface everywhere marked with red stripes or bands, each ending in or starting from a large and deep red cavity in the sward! But soon the plow will come, equalizing and obliterating and writing another history upon the page.

There is something to me peculiarly interesting in stone walls — a kind of rude human expression to them, suggesting the face of the old farmer him-

A WALK IN THE FIELDS

self. How they climb the hills and sweep through the valleys. They decay not, yet they grow old and decrepit; little by little they lose their precision and firmness, they stagger, then fall. In a still, early spring morning or April twilight one often hears a rattle of stones in a distant field; some bit of old wall is falling. The lifetime of the best of them is rarely threescore and ten. The other day, along the highway, I saw an old man relaying a dilapidated stone wall. "Fifty-three years ago," he said, "I laid this wall. When it is laid again, I shan't have the job." It is rarely now that one sees a new wall going up. The fences have all been built, and the farmer has only to keep them in repair.

When you build a field or a highway wall, do not make the top of it level across the little hollows; let it bend to the uneven surface, let it look flexible and alive. A foundation wall, with its horizontal lines, looks stiff and formal, but a wall that undulates along like a live thing pleases the eye.

When I was a boy upon the old farm, my father always "laid out" to build forty or fifty rods of new wall, or rebuild as many rods of old wall, each spring. It is true husbandry to fence your field with the stones that incumber it, to utilize obstacles. The walls upon the old farm of which I am thinking have each a history. This one, along the lower side of the road, was built in '46. I remember the man who laid it. I even remember something of

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the complexion of the May days when the work was going on. It was built from a still older wall, and new material added. It leans and staggers in places now like an old man, but it is still a substantial fence. This one upon the upper side of the road, my father told me he built the year he came upon the farm, which was in '28. He paid twenty cents a rod for having it laid to a man whose grandchildren are now gray-haired men. The wall has a rock foundation, and it still holds its course without much wavering.

The more padding there is in a stone wall, the less enduring it is. Let your stone reach clean through. A smooth face will not save it; a loose and cobbly interior will be its ruin. Let there be a broad foundation, let the parts be well bound together, let the joints be carefully broken, and, above all, let its height not be too great for its width. If it is too high, it will topple over; if its interior is defective, it will spread and collapse. Time searches out its every weakness, and respects only good material and good workmanship.

V

GAY PLUMES AND DULL

I

NOT long since, one of our younger naturalists sent me a photograph of a fawn in a field of daisies, and said that he took the picture to show what he considered the protective value of the spots. The white spots of the fawn did blend in with the daisies, and certainly rendered the fawn less conspicuous than it would have been without them, but I am slow to believe that the fawn has spots that it may the better hide in a daisy-field, or, in fact, anywhere else, or that the spots have ever been sufficiently protective to have materially aided in the perpetuity of the deer species. What use they have, if any, I do not know, any more than I know what use the spots on the leopard or the giraffe have, or the stripes on the zebra. I can only conjecture concerning their use. The panther does not have spots, and seems to get along just as well without them. The young of the moose and the caribou and the pronghorn are not spotted, and yet their habitat is much the same as that of the deer.

Why some forest animals are uniformly dark

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colored, while others are more or less brilliantly striped or spotted, is a question not easily answered. It is claimed that spotted and striped species are more diurnal in their habits, and frequent bushes and open glades, while the dusky species are more nocturnal, and frequent dense thickets. In a general way this is probably true. A dappled coat is more in keeping with the day than with the night, and with bushes and jungles rather than with plains or dense forests. But whether its protective value, or the protective value of the dusky coat, is the reason for its being, is another question.

' This theory of the protective coloration of animals has been one of the generally accepted ideas in all works upon natural history since Darwin's time. It assumes that the color of an animal is as much the result of natural selection as any part of its structure — natural selection picking out and preserving those tints that were the most useful in concealing the animal from its enemies or from its prey. If in this world no animal had ever preyed upon another, it is thought that their colors might have been very different, probably much more bizarre and inharmonious than they are at present.

Now I am not going to run amuck upon this generally accepted theory of modern naturalists, but I do feel disposed to shake it up a little, and to see, if I can, what measure of truth there is in it. That there is a measure of truth in it I am con-

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vinced, but that it has been greatly overworked in our time, and that more has been put upon it than it can bear, of this also I am convinced.

I think we are safe in saying that a bird is protectively colored when the color, as it were, strikes in, and the bird itself acts upon the theory that it is in a measure hidden behind its assimilative plumage. This is true of nearly all the grouse tribe. These birds seem instinctively to know the value of their imitative tints, and are tame or wild according as their tints do or do not match the snow on the ground. The snow keeps the secrets of the snow, and the earth keeps the secrets of the earth, but each tells upon the other. Sportsmen tell me that quail will not "lay" when there is snow upon the ground. The snow gives them away; it lights up their covers in the weeds and the bog as with a lamp. At other times the quail will "lay" till the hunter almost steps upon them. His dog sometimes picks them up. What is the meaning of this behavior but that the bird feels hidden in the one case and not in the other? Moreover, the grouse are all toothsome; and this fact of the toothsome-ness of some birds and the toughness and unsavoriness of others, such as the woodpecker, the crow tribe, gulls, divers, cormorants, and the like, has undoubtedly played some part in their natural history. But whether they are dull-colored because they are toothsome, or toothsome because they are dull-

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colored — who shall say? Which was first, the sweetness or the color? The flesh of the quail and the partridge having become very delectable and much sought after by many wild creatures, did Nature make compensation by giving them their assimilative plumage? or were the two facts inseparable from the first? Yet the flesh of the peacock is said to be as delicate as that of the turkey.

The sweetness of an animal's flesh is doubtless determined by its food. I believe no one eats the Western road-runner, though it is duller of color than the turkey. Its food is mice, snakes, lizards, centipedes, and other vermin.

Thus far I can follow the protective-colorists, but not much farther.

Wallace goes to the extent of believing that even nuts are protectively colored because they are not to be eaten. But without the agency of birds and the small rodents, the wingless nuts, such as chestnuts, acorns, hickory nuts, and butternuts, could never get widely scattered; so that if they were effectively concealed by their colors, this fact would tend to their extinction.

If the colors of animals were as vital a matter, and the result of the same adaptive and selective process, as their varied structures, which Darwin and Wallace teach, then it would seem to follow that those of the same habits and of the same or similar habitat would be similar or identical in

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color, which is not commonly the case. Thus among the birds, the waders all have long legs and long necks, but they are not all of the same color. The divers all have short legs placed in the rear, but they vary greatly in color-markings. How greatly the ducks differ in coloration, though essentially the same in structure! Our tree warblers are of all hues and combinations of hues, though so alike in habit and form. The painted bunting in the Southwest is gaudily colored, while its congeners are all more plainly dressed.

In England the thrush that answers to our robin, being almost identical in form, manner, and habit, is black as a coal. The crow tribe are all built upon the same plan, and yet they show a very great diversity of colors. Why is our jay so showily colored, and the Canada jay so subdued in tint?

The hummingbirds do not differ much in their anatomy, but their tints differ as much as do those of precious stones. The woodpeckers show a variety of markings that cannot be accounted for upon any principle of utility or of natural selection. Indeed, it would seem as if in the colors of birds and mammals Nature gave herself a comparatively free hand, not being bound by the same rigid necessity as in their structures. Within certain limits, something like caprice or accident seems to prevail. The great law of assimilation, or harmonious blending, of which I shall presently have more to say, goes on,

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but it is checked and thwarted and made sport of by other tendencies.

Then the principle of coloration of the same species does not always hold good in different parts of the earth. Our northern flycatchers are all of dull plumage, but in Mexico we find the vermilion flycatcher, with under parts of bright scarlet, and in Java is a flycatcher like a flame of fire. With us, as soon as a bird touches the ground it takes on some ground colors. All our ground-feeders are more or less ground-tinted. But in the East this is not to the same extent true. Thus our pigeons and doves are blue-gray and buff. In the Molucca Islands there is a blue and purple dove, and one species with coppery green plumage, a snow-white tail, and snow-white pendent feathers on the neck. Our thrushes are ground-feeders and are ground-colored. The ground thrushes of the Malay Archipelago are much more brilliantly marked. One species has the "upper parts soft green, the head jet black, with a stripe of blue and brown over the eye; at the base of the tail and on the shoulders are bands of bright silvery blue, and the under-sides are of delicate buff with a stripe of rich crimson bordered with black on the belly." Another ground thrush is velvety black above, relieved by a breast of pure white, shoulders of azure blue, and belly of vivid crimson — one of the most beautiful birds of the East, Wallace says. The Eastern kingfishers are

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also much more brilliant than ours. Our gallinaeous birds are all dull neutral-tinted, but look at this family of birds in the Orient, brilliant beyond words to paint! In Africa the sand grouse is brilliantly marked. There are also snow-white herons in Africa, and black and white ibises. On the Aru Islands in the Malay Archipelago is a flycatcher that is brilliant black and bright orange.

In our hemisphere the swans are white, the pigeons are blue, and the parrots are green. In Australia the swans are black, and there is a black pigeon and a black parrot. In the desert of Sahara most of the birds are desert-colored, but there are some that are blue, and others that are black or brown and white. It is said that the Arctic fox, which is snow-white in most other places, remains blue all winter in Iceland. No doubt there are reasons for all these variations, but whatever these reasons are, they do not seem to favor the theory of protective coloration.

The more local an animal is, the more its color assimilates with its surroundings; or perhaps I should say, the more uniform its habitat, the more assimilative its coloring. The valley quail of California frequents trees and roosts in trees, hence its coloring is not copied from the ground. It is darker and bluer than our Bob White.

Nature dislikes incongruities, and permits them under protest. The fleet rabbit with eyes ever open

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is as protectively colored as the toad or the tortoise. The porcupine with his armor of quills is as hidden from the eye as the coon, or the woodchuck, or the prairie-dog. Climbing things are as well hidden as creeping things, the mole in the ground as well as the mouse on the surface, the squirrel that flies as well as the squirrel that runs, creatures of the night as well as creatures of the day, the elephant, the rhinoceros, the hippopotamus, as well as the smaller animals that are preyed upon. If birds are colored to conceal them from hawks, why are the wild boar, the deer, the hare, similarly colored? They are not hiding from hawks; their enemies go by scent. The hippopotamus in the Nile is as protectively colored as the camel on the sands, and yet in neither case can protection be the end sought. In Africa there is a white rhinoceros. Behold our mountain goat nearly as white as snow against the dark background of the rocks and mountain-slopes where he lives, and yet he appears to thrive as well as the protectively colored deer. Does not the lion without stripes fare just as well as the tiger with? Does not our vermilion flycatcher fare just as well as its cousins of duller plumes? Does not the golden pheasant fare as well as the protectively colored grouse? Everywhere the creative energy seems to have its plain, modest moods and its gaudy, bizarre moods, both in the vegetable and the animal worlds. Why are some flowers so gaudy and others

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so plain, some so conspicuous and others so hidden, some insects so brilliant and others so dull, some fruits so highly colored and others so neutral? This law of endless variation is no doubt at the bottom of all these things. The bird has varied in color from its parent, and as the variation has not told against it, it has gone on and intensified. So with the flowers. I don't believe cherries are red or black to attract the birds, or plums blue. Poisonous berries are as brilliant as harmless ones. No doubt there is a reason for all these high colors, and for the plain ones, if we could only find it. Of course, food, environment, climate, have much to do with it all.

Probably, if we could compare the food which our grouse eats with that which the brilliant pheasants of the East eat, or the food of our wild turkey with that of the Central American bird, or of our pigeons with those of the Malay Archipelago, we might hit upon some clue to their difference of coloration. The strange and bizarre colors and forms of the birds of Africa compared with those of North America or of Europe may be a matter of food. Why our flicker is brighter colored than our other woodpeckers may be on account of the ants he eats.

Mr. Wallace in one of his essays points out the effect of locality on color, many species of unrelated genera both among insects and among birds being marked similarly, with white or yellow or black,

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as if from the effect of some fashion that has spread among them. In the Philippine Islands metallic hues are the fashion; in some other islands very light tints are in vogue; in still other localities unrelated species favor crimson or blue. Mr. Wallace says that among the various butterflies of different countries this preference for certain colors is as marked as it would be if the hares, marmots, and squirrels of Europe were all red with black feet, while the corresponding species of Central Asia were all yellow with black heads, or as it would be if our smaller mammals, the coon, the possum, the squirrels, all copied the black and white of the skunk. The reason for all this is not apparent, though Wallace thinks that some quality of the soil which affects the food may be the cause. It is like the caprice of fashion. In fact, the exaggerated plumes, fantastic colors, and monstrous beaks of many birds in both hemispheres have as little apparent utility, and seem to be quite as much the result of caprice, as are any of the extreme fashions in dress among human beings.

Our red-shouldered starlings flock in the fall, and they are not protectively colored, but the bobolinks, which also flock at the same time, do then assume neutral tints. Why the change in the one case and not in the other, since both species feed in the brown marshes? Most of our own ground birds are more or less ground-colored; but here on the ground, amid

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the bushes, with the brown oven-bird and the brown thrasher, is the chewink with conspicuous markings of white and black and red. Here are some of the soft gray and brown tinted warblers nesting on the ground, and here is the more conspicuous striped black and white creeping warbler nesting by their side. Behold the rather dull-colored great crested flycatcher concealing its nest in a hollow limb, and its congener the brighter-feathered king-bird building its nest openly on the branch above.

Hence, whatever truth there may be in this theory of protective coloration, one has only to look about him to discover that it is a matter which Nature does not have very much at heart. She plays fast and loose with it on every hand. Now she seems to set great store by it, the next moment she discards it entirely.

If dull colors are protective, then bright colors are non-protective or dangerous, and one wonders why all birds of gay feather have not been cut off and the species exterminated: or why, in cases where the males are bright-colored and the females of neutral tints, as with our scarlet tanager and indigo-bird, the females are not greatly in excess of the males, which does not seem to be the case.

II

We arrive at the idea that neutral tints are protective from the point of view of the human eye

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Now if all animals that prey upon others were guided by the eye alone, there would be much more in the theory than there is. But none of the predaceous four-footed beasts depend entirely upon the eye. The cat tribe does to a certain extent, but these creatures stalk or waylay moving game, and the color does not count. A white hare will evidently fall a prey to a lynx or a cougar in our winter woods as easily as a brown rabbit; and will not a desert-colored animal fall a prey to a lion or a tiger just as readily as it would if it were white or black? Then the most destructive tribes of all, the wolves, the foxes, the minks, the weasels, the skunks, the coons, and the like, depend entirely upon scent. The eye plays a very insignificant part in their hunting, hence again the question of color is eliminated.

Birds of prey depend upon the eye, but they are also protectively colored, and their eyes are so preternaturally sharp that no disguise of assimilative tints is of any avail against them. If both the hunted and its hunter are concealed by their neutral tints, of what advantage is it to either? If the brown bird is hidden from the brown hawk, and *vice versa*, then are they on an equal footing in this respect, and the victory is to the sharpest-eyed. If, as is doubtless the case, the eye of the hawk sharpens as the problem of his existence becomes more difficult, then is the game even, and the quarry

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has no advantage — the protective color does **not** protect.

Why should the owl, which hunts by night, be colored like the hawk that hunts by day? If the owl were red, or blue, or green, or black, or white, would it not stand just as good a chance of obtaining a subsistence? Its silent flight, its keenness of vision, and the general obscurity are the main matters. At night color is almost neutralized. Would not the lynx and the bobcat fare just as well if they were of the hue of the sable or the mink? Are their neutral grays or browns any advantage to them? The gray fox is more protectively colored than the red; is he therefore more abundant? Far from it; just the reverse is true. The same remark applies to the red and the gray squirrels.

The northern hare, which changes to white in winter, would seem to have an advantage over the little gray rabbit, which is as conspicuous upon the snow as a brown leaf, and yet such does not seem to be the case. It is true that the rabbit often passes the day in holes and beneath rocks, and the hare does not; but it is only at night that the natural enemies of each — foxes, minks, weasels, wildcats, owls — are abroad.

It is thought by Wallace and others that the skunk is strikingly marked as a danger signal, its contrast of black and white warning all creatures to pass by on the other side. But the magpie is

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marked in much the same way, as is also our bobolink, which, in some localities, is called "the skunk-bird," and neither of these birds has any such reason to advertise itself as has the skunk. Then here is the porcupine, with its panoply of spears, as protectively colored as the coon or the woodchuck, — why does not it have warning colors also? The enemy that attacks it fares much worse than in the case of its black and white neighbor.

The ptarmigan is often cited as a good illustration of the value of protective coloration, — white in winter, particolored in spring, and brown in summer, — always in color blending with its environment. But the Arctic fox would not be baffled by its color; it goes by scent; and the great snowy owl would probably see it in the open at any time of year. On islands in Bering Sea we saw the Arctic snowbird in midsummer, white as a snowflake, and visible afar. Our northern grouse carry their gray and brown tints through our winters, and do not appear to suffer unduly from their telltale plumage. If the cold were as severe as it is farther north, doubtless they, too, would don white coats, for the extreme cold seems to play an important part in this matter, — this and the long Arctic nights. Sir John Ross protected a Hudson's Bay lemming from the low temperature by keeping it in his cabin, and the animal retained its summer coat; but when he exposed it to a temperature of thirty degrees below

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zero, it began to change to white in a single night, and at the end of a week was almost entirely so. It is said that in Siberia domestic cattle and horses become lighter-colored in the winter, and Darwin says he has known brown ponies in England to become white during the same season.

Only one of our weasels, the ermine, becomes white in winter; the others keep their brown coats through the year. Is this adaptive color any advantage to the ermine? and are the other weasels handicapped by their brown tints?

The marten, the sable, and the fisher do not turn white in the cold season, nor the musk ox, nor the reindeer. The latter animals are gregarious, and the social spirit seems to oppose local color.

Apart from the intense cold, the long Arctic nights no doubt have much to do with the white of Arctic animals. "Absence of light leads to diminution or even total abolition of pigmentation, while its presence leads to an increase in some degree proportionate to the intensity of the light."¹

When the variable northern hare is removed to a milder climate, in the course of a few years it ceases to turn white in winter.

The more local an animal is, the more does it incline to take on the colors of its surroundings, as may be seen in the case of the toads, the frogs, the snakes, and many insects. It seems reasonable

¹ Vernon on *Variation in Animals and Plants*.

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that the influence of the environment should be more potent in such cases. The grasshoppers in the fields are of all shades of green and brown and gray, but is it probable that these tints ever hide them from their natural enemies — the sharp-eyed birds and fowls? A grasshopper gives itself away when it hops, and it always hops. On the sea-coast I noticed that the grasshoppers were gray like the sands. What fed upon them, if anything, I could not find out, but their incessant hopping showed how little they sought concealment. The nocturnal enemies of grasshoppers, such as coons and skunks, are probably not baffled at all by their assimilative colors.

Our wood-frog (*Rana sylvatica*) is found throughout the summer on the dry leaves in the woods, and it is red like them. When it buries itself in the leaf mould in the fall for its winter sleep, it turns dark like the color of the element in which it is buried. Can this last change be for protection also? No enemy sees it or disturbs it in that position, and yet it is as “protectively” colored as in summer. This is the stamp of the environment again.

The toad is of the color of the ground where he fumbles along in the twilight or squats by day, and yet, I fancy, his enemy the snake finds him out without difficulty. He is of the color of the earth because he is of the earth earthy, and the bullfrog is of the color of his element, — but there are the

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little green frog, and the leopard frog, and the pickerel frog, all quite showily marked. So there we are, trying to tabulate Nature when she will not be tabulated! Whether it be the phrase "protective coloration," or the imprint of the environment, with which we seek to capture her, she will not always be captured. In the tropics there are gaudily colored tree-frogs, — blue, yellow, striped, — frogs with red bodies and blue legs, and these showy creatures are never preyed upon, they are uneatable. But the old question comes up again — are the colors to advertise their uneatableness, or are they the necessary outcome, and would they be the same in a world where no living thing was preyed upon by another? The acids or juices that make their flesh unpalatable may be the same that produce the bright colors. To confound the cause with the effect is a common error. I doubt if the high color of some poisonous mushrooms is a warning color, or has any reference to outward conditions. The poison and the color are probably inseparable.

The muskrat's color blends him with his surroundings, and yet his enemies, the mink, the fox, the weasel, trail him just the same; his color does not avail. The same may be said of the woodchuck. What color could he be but earth color? and yet the wolf and the fox easily smell him out. If he were snow-white or jet-black (as he sometimes is), he would be in no greater danger.

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I think it highly probable that our bluebird is a descendant of a thrush. The speckled breast of the young bird indicates this, as does a thrush-like note which one may occasionally hear from it. The bird departed from the protective livery of the thrush and came down its long line of descent in a showy coat of blue, and yet got on just as well as its ancestors. Gay plumes were certainly no handicap in this case. Are they in any case? I seriously doubt it. In fact, I am inclined to think that if the birds and the mammals of the earth had been of all the colors of the rainbow, they would be just about as numerous.

The fact that this assimilative coloring disappears in the case of animals under domestication, — that the neutral grays and browns are followed by white and black and particolored animals, — what does that prove? It proves only that the order of Nature has been interfered with, and that as wild instinct becomes demoralized under domestication, so does the wild coloration of animals. The conditions are changed, numberless new influences are brought to bear, the food is changed and is of greater variety, climatic influences are interfered with, multitudes of new and strange impressions are made upon each individual animal, and Nature abandons her uniformity of coloration and becomes reckless, so to speak, not because the pressure of danger is removed, but because the danger is of a

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new and incalculable kind — the danger from man and artificial conditions. Man demoralizes Nature whenever he touches her, in savage tribes and in animal life, as well as in the fields and woods. He makes sharp contrasts wherever he goes, in forms, in colors, in sounds, in odors, and it is not to be wondered at that animals brought under his influence come in time to show, more or less, these contrasts. The tendency to variation is stimulated; form as well as color is rapidly modified; the old order is broken up, and the animal comes to partake more or less of the bizarre condition that surrounds it. Nature when left to herself is harmonious; man makes discords, or harmony of another order. The instincts of wild animals are much more keen and invariable than are those of animals in domestication, the conditions of their lives being far more rigid and exacting. Remove the eggs from a wild bird's nest and she instantly deserts it; but a domestic fowl will incubate an empty nest for days. For the same reason the colors of animals in domestication are less constant than in the wild state; they break up and become much more bizarre and capricious.

Cultivated plants depart more from a fixed type than do plants of the fields and the woods. See what *outré* forms and colors the cultivated flowers display!

The pressure of fear is of course much greater

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upon the wild creatures than upon the tame, but that the removal or the modification of this should cause them to lose their neutral tints is not credible. The domestic pigeons and the barnyard fowls are almost as much exposed to their arch enemy, the hawk, as is the wild pigeon or the jungle fowl, if not more, since the wild birds are free to rush to the cover of the trees and woods. And how ceaseless their vigilance! what keen eyes they have for hawks, whether they circle in the air or walk about in the near fields! In fact, the instinct of fear of some enemy in the air above has apparently not been diminished in the barnyard fowls by countless generations of domestication. Let a boy shy a rusty pie-tin or his old straw hat across the henyard, and behold what a screaming and a rushing to cover there is! This ever watchful fear on the part of the domestic fowls ought to have had some effect in preserving their neutral tints, but it has not. A stronger influence has come from man's disruption of natural relations.

Why are ducks more variously and more brilliantly colored than geese? I think it would be hard to name the reason. A duck seems of a more intense nature than a goose, more active, more venturesome; it takes to the bypaths, as it were, while the goose keeps to a few great open highways; its range is wider, its food supply is probably more various, and hence it has greater adaptiveness and variabil-

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ity. The swan is still more restricted in its range and numbers than the goose, and, in our hemisphere, is snow-white. The factor of protective coloration, so pronounced in the case of the goose, is quite ignored in the swan. Neither the goose nor the swan, so far as I know, has any winged enemies, but their eggs and young are doubtless in danger at times from foxes and wolves and water animals. The duck must have more enemies, because it is smaller, and is found in more diverse and sundry places. Upon the principle that like begets like, that variety breeds variety, one would expect the ducks to be more brightly and variously colored than their larger congeners, the geese and the swans.

The favorite notion of some writers on natural history, that it is a protective device when animals are rendered less conspicuous by being light beneath and dark above, seems to me a hasty conclusion. This gradation in shading is an inevitable result of certain fixed principles. It applies to inanimate objects also. The apples on the tree and the melons in the garden are protectively shaded in the same way; they are all lighter beneath and deeper-colored above. The mushrooms on the stumps and trees are brown above and white beneath. Where the light is feeblest the color is lightest, and *vice versa*. The under side of a bird's wing is, as a rule, lighter than the top side. The

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stronger the light, the more the pigments are developed. All fish that I am acquainted with are light beneath and dark above. If this condition helps to conceal them from their enemies, it is merely incidental, and not the result of laws working to that end.

III

"The danger of the mother bird during incubation" is a phrase often used by Darwin and by more recent writers. This danger is the chief reason assigned for the more obscure coloring of the female among so many species. Now it would seem that the dangers of the mother bird during incubation ought to be far less than those of her more brilliantly colored mate, flitting from tree to tree and advertising his whereabouts by his calls and song, or absorbed in procuring his food; or than those of other females, flying about exposed to the eye of every passing hawk. The life of most wild creatures is like that of a people engaged in war: enemies lurk on every hand, and the danger to the sitting bird may be compared in degree to that of the wife rocking the cradle by her fireside; while her roving mate must face perils equal to those of a soldier on a campaign. The mother bird is generally well hidden, and has nothing to do but to use her eyes and ears, and she usually does this to good purpose. Indeed, I believe the sitting bird is rarely destroyed. I have never known it to happen, though this fact

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does not prove very much. The peril is to the eggs or to the unfledged young; these cannot run or fly away. Eliminate this danger — this and the danger from storms and cold — and the numbers of our birds would probably double in a single year. Hence the care the birds take to conceal their nests, not for the mother bird's sake, but for the sake of the treasures which she cannot defend. In some cases she appears to offer herself an easy victim in order to lure the intruder away. She would have him see only herself when she flutters, apparently disabled, over the ground. The game of concealment has failed; now she will try what feigning can do.

All the species of our birds in which the male is more brilliantly colored than the female, such as the scarlet tanager, the indigo-bird, the rose-breasted grosbeak, the goldfinch, the summer tanager, the Virginia cardinal, the blue grosbeak, build in trees or low bushes, and it seems to me that the dull tints of the female would play but little part in concealing the nest. The enemies of these birds — as of most of our birds — are crows, squirrels, black snakes, jays, weasels, owls, and hawks, and have been for untold generations. Now the obscure coloring of the female would play no part in protecting her against any of these creatures. What would attract their attention would be the nest itself. The crows, the jays, the weasels, the squirrels, explore the trees looking for eggs and

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young birds, as doubtless the owls do by night. The mother bird flies at their approach, and leaves her eggs or young to be devoured. The sitting bird usually is not visible to an enemy passing in the air above, as she is hidden by the leaves. In the care of the young the male is as active and as much exposed to danger as is the female, and in the case of the scarlet tanager the male seems the bolder and the more active of the two; yet the female, because of her obscure coloring, could afford to run many more chances than he.

With the ground-builders the case is not much different. These birds are preyed upon by prowlers, — skunks, weasels, rats, snakes, crows, minks, foxes, and cats, — enemies that hunt at close range by night and by day, and that search the ground by sight and by smell. It is not the parent bird, but the eggs and the young, that they capture. Indeed, I cannot see that the color of the sitting bird enters into the problem at all. Red or white or blue would not endanger the nest any more than would the neutral grays and browns. The bobolink builds in meadows where the grass alone conceals it. That the back of the sitting bird harmonizes perfectly with the meadow bottom might make a difference to the egg-collector, or to an eye a few feet above, but not to the mink, or the skunk, or the snake, or the fox, that came nosing about the very spot.

Last summer I saw where a woodcock had made

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her nest in a dry, grassy field many yards from a swamp in the woods, which was her natural habitat. The instinct of the bird seemed to tell her that she would be less exposed to her prowling enemies in the dry, open field than in the thick, swampy woods, and her instinct was, no doubt, a safe guide. Her imitative color would avail her but little in either place. The same may be said of the quail and of the grouse. Their neutral tints may protect them from the human eye, but not from their natural enemies. Could the coon, or the mink, or the fox, or the skunk be baffled by them? Is the setter or pointer baffled? Both the quail and the partridge, in settled countries, are very likely to nest along roads and paths, away from thick jungles and tangles that would afford cover to their enemies. It is their eggs and their newly hatched young that they are solicitous about. Their wings afford security to themselves. True, the sitting bird usually allows the passer-by to approach her very closely, but I have reason to believe that she is much sooner alarmed by an animal that approaches stealthily, nosing about, making very little noise, than by the passing of a person or of the large grazing animals. Her old traditional enemies are stealthy and subtle, and her instinct keeps her on her guard against them. A person walking boldly along, occupied about his own business, can pass within a few feet of a partridge on his drumming log. But let a man try

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to creep up on the drumming partridge, and the bird will instantly show how wary and suspicious he is.

The female cowbird is much duller in color than the male, and yet she is a parasitical bird, and does no incubating at all. With the rose-breasted grosbeak, the male seems to do his share of the incubating, and has been heard to sing upon the nest.

A fact that seems to tell against the notions I have been advancing, and that gives support to the theory of the protective value of dull colors, is the fact that with those species of birds in which both sexes are brightly colored, the nest is usually placed in a hole, or is domed, thus concealing the sitting bird. This is true of a large number of species, as the bluebird, the woodpeckers, the chickadee, the nuthatch, the kingfisher, and, in the tropics, the various species of parrots and parrakeets and many others, all birds of brilliant plumage, the sexes being in each case indistinguishable. But there are such marked exceptions to this rule that, it seems to me, its force is greatly weakened. Our blue jay is a highly colored bird, and yet it builds an open nest. The crow builds an open nest. The passenger pigeon was a bird of rather showy colors, and the male did his share of the incubating, still the nest was built openly. The shrike is a conspicuously marked bird, and it builds an open nest. Mr. Wallace names four other brilliant Old-World birds that build open nests. Then there are several

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species of birds, in which the female is obscurely marked, that build in holes and cavities, such as our wrens, the great crested flycatcher, the European starling, the English sparrow, the bush-tits of California, and the wood duck. The female oriole is much duller-colored than her mate, yet she builds a pocket nest. Of course these last cases do not prove that there is not greater safety in a hidden nest, they only show that the color of the mother bird is not the main factor in the problem. But that a bird in a hole is safer than a bird in an open nest may well be doubted. The eggs are probably more secure from the thievish crow and the blue jay, but not from rats and squirrels and weasels. I know that the nests of the bluebird and the chickadee are often broken up by some small enemy.

We fancy that the birds are guided by their instinct for protective colors in the materials they choose for their nests. Most birds certainly aim to conceal their nests — the solitary builders, but not those that nest in communities, like the cliff swallows and rooks and flamingoes — and the materials they use favor this concealment. But what other materials could they use? They choose the material everywhere near at hand, — moss, leaves, dry grass, twigs, mud, and the like. The ground-builders scrape together a few dry straws and spears of grass; the tree-builders, twigs and lichens and cotton and rootlets and other dry wood

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products. There is nothing else for them to use. If a man builds a hut or a shanty in the fields or woods with such material as he finds ready at hand, his habitation will be protectively colored also. The winter wren builds its mouse-like nest of green moss, but in every case that has come under my observation the nest has been absolutely hidden by its position under a log or in a stump, or amid the roots of trees, and the most conspicuous colors would not have betrayed it to its enemies. In fact, the birds that build hidden nests in holes or tree cavities use of necessity the same neutral materials as those that build openly.

Birds that deliberately face the exterior of their nests with lichens obtained from rocks and trees, such as the hummingbird, the blue-gray gnat-catcher, and the wood pewee, can hardly do so with a view to protection, because the material of their nests is already weather-worn and inconspicuous. The lichens certainly give the nest an artistic finish and make it a part of the branch upon which it is placed, to an extent that suggests something like taste in the builders. But I fail to see how a marauding crow, or a jay, or a squirrel, or a weasel, or any other enemy of the bird could be cheated by this device.

IV

I find myself less inclined to look upon the neutral grays and browns of the animal world as the result

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of the struggle for existence, but more disposed to regard them as the result of the same law or tendency that makes nature in general adaptive and harmonious — the outcome of the blendings, the adjustments, the unifying processes or tendencies that are seen and felt all about us. Is not open-air nature ever striving toward a deeper harmony and unity? Do not differences, discrepancies, antagonisms, tend to disappear? Is there not everywhere something at work to bring about agreements, correspondences, adaptations? to tone down contrasts, to soften outlines, to modify the abrupt, to make peace between opposites? Is not the very condition of life and well-being involved in this principle? The abrupt, the disjoined, the irreconcilable, mean strife and dissolution; while agreements, gradations, easy transitions, mean life and growth. Like tends to beget like; the hand is subdued to the element it works in. The environment sets its stamp more or less strongly upon all living things. Even the pyramids are the color of the sands. Leave your bones there, and they will soon be of the same tint. Even your old boots or old coat will in time come to blend a little with the desert.

The tendency in nature that is over all and under all is the tendency or effort toward harmony — to get rid of strife, discord, violent contrasts, and to adjust every creature to its environment. Inside of this great law or tendency are the lesser

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laws of change, variety, opposition, contrast. Life must go on, and life for the moment breaks the unity, the balance. May not what is called protective coloration be largely this stamp of the environment, this tendency to oneness, to harmony and simplicity, that pervades nature, organic no less than inorganic?

Things in nature blend and harmonize; one thing matches with another. All open-air objects tend to take on the same color-tones; everything in the woods becomes woodsy, things upon the shore get the imprint of the shore, things in the water assume the hues of the water, the lichen matches the rock and the trees, the shell matches the beach and the waves; everywhere is the tendency to unity and simplicity, to low tones and adaptive colors.

One would not expect animals of the plains or of the desert to be colored like those of the bush or of the woods; the effects of the strong uniform light in the one case and of the broken and checkered light in the other would surely result in different coloration. That never-ending brown or gray or white should not in time stamp itself upon the creatures living in the midst of them is incredible.

Through the action of this principle, water animals will be water-colored, the fish in tropic seas will be more brilliantly colored than those in northern seas, tropical birds and insects will be of gayer

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hues than those of the temperate zones, shore birds will be shore-tinted, Arctic life will blend more or less with Arctic snows, ground animals will assimilate to the ground colors, tree animals will show greater variety in tint and form, plains animals will be dull of hue like the plains — all this, as I fancy, not primarily for protection or concealment, but through the law of natural assimilation, like begetting like, variety breeding variety.

What more natural than that strictly wood birds should be of many colors and shades, to be in keeping with their surroundings? Will not the play of light and shade, the multiplicity of forms, and the ever moving leaves come in time to have their due effect? Will not a variety of influences tend to produce a variety of results? Will not sameness breed sameness? Would not one expect the hummingbirds to be more brilliant than the warblers, and the warblers more varied in color than the finches? the insect-feeders than the seed-eaters? The hummingbirds are, as it were, begotten by the flowers and the sunshine, as the albatross is begotten by the sea, and the whippoorwill by the dusk. The rat will not be as bright of tint as the squirrel, nor the rabbit as the fox.

In the spring one may sometimes see a bluebird, or a redbird, or a bright warbler for a moment upon the ground. How artificial and accidental it looks, like a piece of ribbon or a bit of millinery dropped

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there! It is not one with the ground, it is not at home there. In the tree it is more in keeping with the changing forms and the sharper contrasts.

The environment is potent in many ways. Everything is modified by the company it keeps. Do not the quiet tints and sounds of the country have their effect upon the health and character of the dwellers there? The citizen differs in look and manner from the countryman, the lawyer from the preacher and the doctor, the seaman from the landsman, the hermit from the cosmopolite. There is the rural dullness, and there is the metropolitan alertness. Local color, local quality, are realities. States, cities, neighborhoods, have shades of difference in speech and manner. The less traveled a people are, the more marked these differences appear. The more a man stays at home, the more the stamp of his environment is upon him. The more limited the range of an animal, the more it is modified by its immediate surroundings. Thus the loon is so much of a water bird that upon the land it can only hobble, and the swallow is so much a creature of the air that its feet are of little use to it. Perfect adaptability usually narrows the range, as the skater is at home only upon the ice.

Here are two closely related birds of ours, the oven-bird and the water-thrush, both with speckled breasts, but each tinted more or less like the ground it walks upon, the one like the dry leaves, the other

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like the brook stones and pond margins. The law of assimilation and of local color has done its perfect work. Were the two birds to change places, each retaining its own color, I do not believe they would be in any more jeopardy than they are now.

The camel is of a uniform gray like the desert where it is at home, while the camelopard, or giraffe, a creature of the trees, is dappled or spotted. Is the color in either case protective? Against what? Their size and movements would disclose them to their natural enemies wherever they were.

The lion is desert-colored too. Is this for concealment from its prey? But it is said that horses and oxen scent the lion long before they can see him, as doubtless do the wild desert creatures upon which he feeds. Their scent would surely be keener than that of our domesticated animals, and to capture them he must run them down or ambush them where the wind favors him. His desert color is the brand of his environment. If his home were the rocks or the mountains, his color would certainly be different. Nothing could be duller or more neutral than the color of the elephant, and surely he is not hiding from any natural enemy, or stalking any game.

The bright colors of many tropical fish, such as the angel-fish, seem only a reflection of the bright element in which they live. The changing brilliant

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hues of tropic seas are expressed in the animal life in them. It is highly improbable that this is for protection; it is the law of assimilation working in the deep. All life in the tropics is marked by greater eccentricity of form and richness of coloring than in the temperate zones, and this is in keeping with the above principle.

V

It seems to me that the question that enters most deeply into the life problem of an animal is the question of food and climate, and of climate only so far as it affects the food supply. Many of our migrating birds will brave our northern winters if they can get anything to eat. A few years ago our bluebirds in the eastern part of the continent were fearfully decimated by a cold wave and an ice storm in the South that cut off their food supply. For two or three years rarely was a bluebird seen in those parts of the country where, before that event, they had been abundant. Then they began to reappear, and now, it seems to me, there are more bluebirds than ever before. Evidently their bright colors have not stood in the way of their increase. If they have now reached their limit, it is because they have reached the limit of their food supply and their nesting-sites.

How abundant are the robins everywhere, how noisy, how conspicuous! I do not doubt in the least

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that if, retaining the same habits, they were scarlet, or white, or indigo, they would be just as numerous as they are now. The robin is a wide, free feeder, boring in the turf for grubs and worms in summer, and taking up with cedar berries and hardhack drupes in winter. If a crop of locusts come in cherry time, he will spare your cherries. If a drouth drives the angleworms deep into the ground in August, look out for your grapes. The robin is wonderfully adaptive. If he does not find a tree to his liking, he will nest on the wall, or under your porch, or even on the ground. His colors are not brilliant, but the secret of his success lies in his courage, his force of character, so to speak, and his adaptability. His European cousin, the blackbird, is less protectively colored, but is of similar habits and disposition, and seems to thrive equally well. Again, contrast the Baltimore oriole with the orchard oriole. If there is anything in protective color, the more soberly colored bird has greatly the advantage, and yet the more brilliant species is far more abundant. The strong contrast of black and orange which the brilliant coats present does not seem to have lessened their wearers' chances of survival. Their pendent nests, beyond the reach of weasels and squirrels and snakes and crows, are no doubt greatly in their favor, but still more so, I believe, are their feeding habits. Compared with the orchard oriole, they are miscellaneous feeders; insects and

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fruit and even green peas are in their bill of fare. When a bird like the orchard oriole is restricted in its range, it is quite certain that its food supply is equally restricted.

Of birds that live upon tree-trunks, here are two of similar habits, one protectively colored and the other not, and yet the one that is of bright tints is far the more numerous. I refer to the nuthatch and the brown creeper. The creeper is so near the color of the bark of the trees upon which it feeds that one has great difficulty in seeing it, while the nuthatch in its uniform of black, white, and blue, contrasts strongly with its surroundings. The creeper works up and around the tree, rarely showing anything but its bark-colored back, while the nuthatch hops up and down and around the tree with head lifted, constantly exposing its white throat and breast. But the nuthatch is the better feeder, it eats nuts as well as the larvæ of insects, while the creeper seems limited to a minute kind of food which it obtains with that slender, curved bill. It can probe, but not break, with this instrument, and is never seen feeding upon the ground, like the nuthatch. I am bound to state, however, that the latter bird has another advantage over the demure creeper, which may offset the danger that might come to it from its brighter color — it is more supple and alert. Its contact with the tree is like that of the rocker with the floor, while the line of the creeper's

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back is more like that of the rocker reversed; it touches head and tail, and has far less freedom of movement than has the nuthatch. The head of the latter often points straight out from the tree, and the eye takes in all the surroundings to an extent that the creeper's cannot.

Of course it is not safe to claim that one can always put his finger upon the exact thing that makes one species of birds more numerous than an allied species; the conditions of all animal life are complex, and involve many factors more or less obscure. In the present case I am only trying to point out how slight a part color seems to play in the problem, and how prominent a part food plays. Our ruffed grouse holds its own against the gunners, the trappers, the hard winters, and all its numerous natural enemies, not, I think, because it is protectively colored, but because it, too, is a miscellaneous feeder, ranging from berries and insects to buds and leaves. The quail has the same adaptive coloring, but not the same range of food supply, and hence is more easily cut off. Birds that subsist upon a great variety of foods, no matter what their coloring, apparently have the best chance of surviving.

VI

There seem to be two instincts in animal life that work against the influence of environment upon the colors of animals, or the tendency in Nature to

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make her neutral grays and browns everywhere prevail — the male instinct of reproduction, which is major, and the social or gregarious instinct, which is minor, but which, I am inclined to believe, has its effect.

The gregarious birds and mammals are as a rule less locally colored than those of solitary habits. Thus the more gregarious elk and antelope and sheep are less adaptively colored than the more solitary deer. The buffalo had not the usual color of a plains animal; the individual was lost in the mass, and the mass darkened the earth. The musk ox goes in herds and does not put on a white coat in the sub-Arctic regions.

Does a solitary life tend to beget neutral and obscure tints in a bird or beast? The flocking birds nearly all tend to bright colors, at least brighter than their solitary congeners. The passenger pigeon furnished a good example near at hand. Contrast its bright hues with those of the more recluse turtle-dove. Most of our blackbirds have a strong flocking instinct, and they are conspicuously colored. The sociability of the cedar-birds may help to account for their crests, their banded tails, and their pure, fine browns. As soon as any of the ground birds show a development of the flocking instinct, their hues become more noticeable, as is the case with the junco, the snow bunting, the shore lark, and the lark bunting of the West. Among the tree *Fringil-*

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lidæ the same tendency may be noticed, the flocking crossbills, pine grosbeaks, redpolls, and the like, all being brighter of color than the solitary sparrows. The robin is the most social of our thrushes, and is the brightest-colored.

In the tropics the parrots and parrakeets and macaws are all strikingly colored, and are all very social. Why should not this be so? Numbers beget warmth and enthusiasm. A multitude is gay of spirit. It is always more noisy and hilarious, more festive and playful, than are single individuals. Each member is less a part of its surroundings and more a part of the flock or the herd. Its associations with nature are less intimate than with its own kind. Sociability, in the human species, tends to express itself in outward symbols and decorations, and why may not the brighter colors of the social birds be the outward expression of the same spirit?

The social flamingo does not, in the matter of color, seem to have been influenced by its environment at all. The gregarious instinct is evidently very strong in the species. Mr. Frank M. Chapman found them in the Bahamas living and breeding in great colonies; he discovered what he calls a flamingo city. The birds all moved and acted in concert. Their numbers showed in the distance like an army of redcoats; they made the land pink. They were adapted to their marsh life by their long legs, and to the food they ate by their bills, but their

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colors contrasted strongly with their surroundings. The community spirit carried things with a high hand. The same is in a measure true of the ibis, the stork, the crane — all birds more or less gregarious, and all birds of more or less gay plumes. But our solitary great blue heron, lone watcher in marshes and by pond and river margins, is obscurely colored, as is the equally solitary little green heron.

Our blue heron will stand for hours at a time on the margin of some lake or pond, or on the top of some forest tree near the water, and the eye might easily mistake him for some inanimate object. He has watched among roots and snags and dead tree-tops so long that he has naturally come to look like these things. What his enemies are, that he should need to hide from them, other than the fool with the gun, I do not know.

Among gregarious mammals the same spirit seems at work to check or modify the influence of the environment.

The common crow illustrates this spirit in a wider field. The crow is a citizen of the world; he is at home everywhere, but in the matter of color he is at home nowhere. His jet black gives him away at all times and in all places. His great cunning and suspicion — whence do they come? From his experiences with man?

I do not know that there is very much in this

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idea as to the effect of the social instinct upon the colors of animals. I only throw it out as a suggestion.

When we come to the reproductive principle or instinct, then do we strike a dominating influence; then is there contrast and excess and riot; then are there positive colors and showy ornaments; then are there bright flowers, red, orange, white, blue; then are there gaudy plumes of birds, and obtrusive forms and appendages in mammals. The old modesty and moderation of nature are abandoned. It is not now a question of harmony and quietude, but of continuing the species. Masses of color appear in the landscape; silent animals become noisy; birds burst into song, or strut and dance and pose before one another; the marshes are vocal; hawks scream and soar; a kind of madness seizes all forms of life; the quail whistles; the grouse drums in the woods, or booms upon the prairie; the shellfish in the sea, and the dull turtle upon the land, feel the new impulse that thrills through nature. The carnival of the propagating instinct is at hand. For this, and begotten by this, are the gaudy colors and the beautiful and the grotesque ornaments.

As a rule, the females are not implicated in this movement or craze to the extent that the males are. Even among the flowering plants and trees in which the two sexes are separated, the male is showy while the female is inconspicuous. The pollen-yield-

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ing catkins of the hazel and of the hickory and oak flaunt in the wind, seen by all passers, while the minute fruit-producing flower is seen by none. Nature always keeps nearer to her low tones, to her neutral ground, in the female than in the male; the female is nearer the neuter gender than is the male. She is negative when he is positive; she is more like the quiet color tones in nature; she represents the great home-staying, conservative, brooding mother principle that pervades the universe. Harmony, repose, flowing lines, subdued colors, are less the gift of the aggressive, warring masculine element than of the withdrawing and gentle feminine element. That the earth is our mother, the sun our father, is a feeling as old as the human race, and throughout the animal world the neutral and negative character of the one and the color and excess of the other still mark the two sexes. Why, in the human species, the woman runs more to the ornate and the superfluous than does the man is a question which no doubt involves sociological considerations that are foreign to my subject.

Darwin accounts for the wide departure from the principle of utility and of protective coloration in the forms and colors of so many birds and mammals upon his theory of sexual selection, or the preference of the female for bright colors and odd forms. Wallace rejects this theory, and attributes these things to the more robust health and vigor of the

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males. However, in the matter of health the females of all species seem on a par with the males, though in many cases the males are the larger and the more powerful. But among our familiar birds, when the two sexes differ in color, the brighter-plumaged male, with rare exceptions, is no larger or more vigorous than the female.

The principle to which I have referred seems to me adequate to account for these gay plumes and fantastic forms — the male sexual principle, the positive, aggressive instinct of reproduction, always so much more active in the male than in the female; an instinct or passion that banishes fear, prudence, cunning, that makes the timid bold, the sluggish active, that runs to all sorts of excesses, that sharpens the senses, that quickens the pulse, that holds in abeyance hunger and even the instinct of self-preservation, that arms for battle and sounds forth the call, and sows contention and strife everywhere; the principle that gives the beard to the man, the mane to the lion, the antlers to the stag, the tusks to the elephant, and — why not? — the gorgeous plumes and bright colors to the male birds of so many species. The one thing that Nature seems to have most at heart is reproduction; she will sacrifice almost everything else to this — the species must be perpetuated at all hazards, and she has, as a rule, laid the emphasis in this matter upon the male. The male in the human species is positive,

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or plus, while the female is negative. The life of the female among the lower animals runs more smoothly and evenly — is more on the order of the neutral tint — than is that of the male. The females of the same group differ from one another much less than do the males. The male carries a commission that makes him more restless, feverish, and pugnacious. He is literally “spoiling for a fight” most of the time. This surplusage, these loaded dice, make the game pretty sure.

Cut off the ugly bull’s horns, and you have tamed him. Castration tames him still more, and changes his whole growth and development, making him approximate in form and disposition to the female. I fancy that the same treatment would have the same effect upon the peacock, or the bird of paradise, or any other bird of fantastic plumage and high color. Destroy the power of reproduction, and the whole masculine fabric of pride — prowess, weapons and badges, gay plumes and decorations — falls into ruins.

When we remember how inattentive and indifferent the females of all species of birds are to the displays of the males before them, it is incredible that their taste in fashions, their preferences for the gay and the ornate, should have played any considerable part in superinducing these things.

Darwin traces with great skill the gradual development of the ball and socket ocelli in the plumage

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of the Argus pheasant. It was evidently a long, slow process. Is it credible that the female observed and appreciated each successive slight change in the growth of these spots, selecting those males in which the changes were most marked, and rejecting the others? How could she be so influenced by changes so slight and so gradual that only a trained eye would be likely to take note of them? It is imputing to the female bird a degree of taste and a power of discrimination that are found only in mankind. Why, then, it may be asked, is the male so active in showing off his finery before the female? Of course it is to move her, to excite her to the point of mating with him. His gay plumes are the badge of his masculinity, and it is to his masculinity that her feminine nature responds. She is aroused when he brings to bear upon her all the batteries of his male sex. She is negative at the start, as he is positive. She must be warmed up, and it is his function to do it. She does not select; she accepts, or rejects. The male does the selecting. He offers himself, and she refuses or agrees, but the initiative is with him always. He would doubtless strut just the same were there no hens about. He struts because he has to, because strutting is the outward expression of his feelings. The presence of the hen no doubt aggravates the feeling, and her response is a reaction to the stimuli he offers, just as his own struttings are reactions to the internal stimuli that are at the

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time governing him. In the Zoo at the Bronx the peacock has been seen to strut before a crow.

Undoubtedly the males in whom the masculine principle is the strongest and most masterful are most acceptable to the females, and the marvelous development of form and color in the peacock, or in the Argus pheasant, might take place under the stimulus of continued success. If there are two rival cocks in the yard, the hens will, as a rule, prefer the victor — the one that struts the most and crows the loudest. How amusing to see the defeated cock fold his wings, depress his plumage, and look as unpretentious and henlike as possible in the presence of his master!

If the male bird sang only while courting the female, we might think he sang only to excite her admiration, but he continues to sing until the young appear, and, fitfully, long after that, his bright colors in many cases gradually disappearing with his declining song impulse, and both fading out as the sexual instinct has run its course. It was the sexual impulse that called them into being, and they decline as it declines. It is this impulse that makes all male birds so pugnacious during the breeding season. Not only does a brighter iris come upon the burnished dove in the spring, but also a warmer glow comes upon the robin's breast, and the hues of all other male birds are more or less deepened and intensified at this time. Among many kinds of

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fish the males put on brighter colors in the spring, and surely this cannot be to win the females, as there is no proper mating among them.

The odd forms and bizarre colors that so often prevail among birds, more especially tropical and semi-tropical birds, and among insects, suggest fashions among men, capricious, fantastic, gaudy, often grotesque, and having no direct reference to the needs of the creatures possessing them. They are clearly the riot and overflow of the male sexual principle — the carnival of the nuptial and breeding impulse. The cock or sham nests of the male wrens seem to be the result of the excess and overflow of the same principle.

It is not, therefore, in my view of the case, female selection that gives the males their bright plumage, but the inborn tendency of the masculine principle to riot and overplus. There is, strictly speaking, no wooing, no courtship, among the four-footed beasts, and yet the badges of masculinity, manes, horns, tusks, pride, pugnacity, are as pronounced here as are the male adornments among the fowls of the air.

Why, among the polygamous species of birds, are the males so much more strongly marked than among the monogamous? Why, but as a result of the superabundance and riot of the male sexual principle? In some cases among the quadrupeds it even greatly increases the size of the males over the females, as among the polygamous fur seals.

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Darwin came very near to the key of the problem that engaged him, when he said that the reason why the male has been the more modified in those cases where the sexes differ in external appearance is that "the males of almost all animals have stronger passions than the females."

"In mankind, and even as low down in the scale as in the *Lepidoptera*, the temperature of the body is higher in the male than in the female." (Darwin.)

If the female refuses the male, it is not because he does not fill her eye or arouse her admiration, but because the mating instinct is not yet ripe. Among nearly all our birds the males fairly thrust themselves upon the females, and carry them by storm. This may be seen almost any spring day in the squabbles of the English sparrows along the street. The female appears to resist all her suitors, defending herself against them by thrusting spitefully right and left, and just what decides her finally to mate with any one of them is a puzzle. It may be stated as a general rule that all females are reluctant or negative, and all males are eager or positive, and that the male wins, not through the taste of the female, — her love for bright colors and ornamental appendages, — but through the dominance of his own masculinity. He is the stronger force, he is aggressive and persuasive, and finally kindles her with his own breeding instinct.

Even among creatures so low in the scale of life

GAY PLUMES AND DULL

as the crab, the males of certain species, during the breeding season, dance and gyrate about the females, assuming many grotesque postures and behaving as if intoxicated — as, indeed, they are, with the breeding passion.

Evidently the female crab does not prefer one male over another, but mates with the one that offers himself, as soon as he has excited her to the mating point. And I have no proof that among the birds the female ever shows preference for one male over another; she must be won, of course, and she is won when the male has sufficiently aroused her; she does not choose a mate, but accepts one at the right time. I have seen two male bluebirds fight for hours over a female, while she sat and looked on indifferently. And I have seen two females fight over a male, while he sat and looked on with equal indifference. "Either will suit, but I want but one."

Of course Nature does not work as man works. Our notions of prudence, of precision, of rule and measure, are foreign to her ways. The stakes are hers, whoever wins. She works by no inflexible system or plan, she is spontaneous and variable every moment. She heaps the measure, or she scants the measure, and it is all one to her. Our easy explanations of her ways — how often they leave us where they found us! The balance of life upon the globe is fairly well maintained by checks and

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counter-checks, by some species being prolific and other species less so, by the development of assimilative colors by one kind, and of showy colors by another, by slow but ceaseless modifications and adaptations. It is a problem of many and complex factors, in which, no doubt, color plays its part, but I believe this part is a minor one.

NOTE.—Since writing the above essay I have read Geddes and Thomson on "The Evolution of Sex," and find that these investigators have anticipated my main idea in regard to the high coloration and ornamentation of male birds, namely that these things inhere in the male principle, or are "natural to maleness." The males put on more beauty than females "because they are males, and not primarily for any other reason whatever." "Bright coloring or rich pigmentation is more characteristic of the male than of the female constitution." "Males are stronger, handsomer, or more emotional simply because they are males, —i. e., of more active physiological habit than their mates." The males tend to live at a loss, and are relatively more *katabolic*; the females, on the other hand, tend to live at a profit, and are relatively more *anabolic*.

"Brilliancy of color, exuberance of hair and feathers, activity of scent-glands, and even the development of weapons, cannot be satisfactorily explained by sexual selection alone, for this is merely a secondary factor. In origin and continued development they are outcrops of a male as opposed to a female constitution."

VI

STRAIGHT SEEING AND STRAIGHT THINKING

I

A NEWSPAPER correspondent the other day asked me what I meant by truth in natural history. "We know that no two persons see alike," he said, "or see the same things; behold the disagreements in the testimony of eye-witnesses to the same occurrences." "True," I replied; "but when two persons shoot at a mark, they must see alike if they are both to hit the mark, and two witnesses to a murder or a robbery must agree substantially in their testimony if they expect to be credited in the court-room." In like manner, two observers in the field of natural history must in the main agree in their statements of fact if their observations are to have any scientific value. Notwithstanding it is true that we do not all see the same things when we go to the fields and woods, there is such a thing as accurate seeing, and there is such a thing as inaccurate seeing and reporting.

By truth in natural history I can mean only that which is verifiable; that which others may see under like conditions, or which accords with the observa-

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tions of others. You may not see just what I do in the lives of the birds or the quadrupeds, but you will see that which belongs to the same order of facts, just as you will in the world of physics. You will not see iron floating and wood sinking under like conditions, or trees growing with their roots in the air. You may see to-day something in the life of a bird, or a bee, or a beast, that neither I nor any one else ever saw before, but it will belong to the same order of things that I and others have seen these creatures do. You will not see a woodchuck hanging to a limb by his tail like a possum, nor a fox sleeping in the top of a tree like a coon, nor a loon running a race between lines of interested spectators, nor crows hoarding trinkets in a hollow stump, nor the old teaching their young this or that, and so on. No, you may send a thousand good observers to the woods every day for a thousand years, and not one of them will see any of the novel and surprising, not to say impossible, things of which the "nature fakers" see so many every time they take a walk. The nature faker's fantastic natural history is not verifiable. I have seen blackbirds build their nests in the side of an osprey's nest, and all seemed to go well — the osprey is exclusively a fish-eater — but if any person were to tell me that he had seen them build their nests alongside of that of the eagle or the hen-hawk, or that he had seen bluebirds breeding in a cavity with

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the hoot owl, I should know him as a faker. The rabbit is not on visiting terms with the fox or the mink, nor do the robins welcome a call from the jays.

I did something the other day with a wild animal that I had never done before or seen done, though I had heard of it: I carried a live skunk by the tail, and there was "nothing doing," as the boys say. I did not have to bury my clothes. I knew from observation that the skunk could not use its battery with effect without throwing its tail over its back; therefore, for once at least, I had the courage of my convictions and verified the fact.

A great many intelligent persons tolerate or encourage our fake natural history on the ground that they find it entertaining, and that it interests the school-children in the wild life about them. Is the truth, then, without value for its own sake? What would these good people think of a United States school history that took the same liberties with facts that certain of our nature writers do: that, for instance, made Washington take his army over the Delaware in balloons, or in sleighs on the solid ice with bands playing; or that made Lincoln a victim of the Evil Eye; or that portrayed his slayer as a self-sacrificing hero; or that represented the little Monitor that eventful day on Hampton Roads as diving under the Merrimac and tossing it ashore on its beak?

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The nature fakers take just this kind of liberties with the facts of our natural history. The young reader finds it entertaining, no doubt, but is this sufficient justification?

Again, I am told that the extravagant stories of our wild life are or may be true from the writer's point of view. One of our publishing houses once took me to task for criticising the statements of one of its authors by charging that I had not considered his point of view. The fact is, I had considered it too well; his point of view was that of the man who tells what is not so. As if there could be more than one legitimate point of view in natural history observation — the point of view of fact!

There is a great deal of loose thinking upon this subject in the public mind.

An editorial writer in a New England newspaper, defending this school of writers, says:—

“Their point of view is that of the great out-of-doors, and comes from loving sympathy with the life they study, and is as different from that of the sportsman and the laboratory zoölogist as a notebook differs from a rifle or a microscope.”

Now how the point of view of the “great out-of-doors” can differ from the point of view of the little indoors in regard to matters of fact is hard to see. A man who watches the ways of an animal in the wilderness, or from the mountain-top, is bound by the same laws of truthfulness as the man who sees

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it through his study window. What the writer means is doubtless that the spirit in which the literary naturalist — the man who goes to the fields and woods for material for literature — treats the facts of natural history differs from the spirit in which the man of pure science treats his. Undoubtedly, but the two alike deal with facts, though with facts of a different order.

The scientist, the artist, the nature-lover, and the like, all look for and find different things in nature, yet there is no contradiction between the different things they find. The truth of one is not the falsehood of another. The field naturalist is interested in the live animal, the laboratory zoölogist in the measuring and dissecting of the dead carcass. What interests one is of little or no interest to the other. So with the field botanist as compared with the mere herbalist. Both are seekers for the truth, but for a different kind of truth. One seeks that kind of truth that appeals to his emotion and to his imagination; the other that kind of truth — truth of structure, relation of parts, family ties — that appeals to his scientific faculties. Does this fact, therefore, give the nature faker warrant to exaggerate or to falsify the things he sees in the fields and woods? Let him make the most of what he sees, embellish it, amplify it, twirl it on the point of his pen like a juggler, but let him beware of adding to it; let him be sure he sees accurately. Let him beware

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of letting invention take the place of observation. It is one thing to work your gold or silver up into sparkling ornaments, and quite another to manufacture an imitation gold or silver, and this is what the nature fakers do. Their natural history is for the most part a sham, a counterfeit. No one quarrels with them because they are not scientific, or because they deal in something more than dry facts; the ground of quarrel is that they do not start with facts, that they grossly and absurdly misrepresent the wild lives they claim to portray.

A Wisconsin editor, writing upon this subject, shoots wide of the mark in the same way as does the New England editor. "Knowledge born of scientific curiosity," he says, "has nothing in common with the study of animal individuality which the 'nature fakers' have fostered and to which the public has proved responsive. There is all the difference in the world between being interested in the length of an animal's skull and being interested in the same animal's ways and personality." True enough, but this is quite beside the mark. The point at issue is a question of accurate seeing and reporting. The man who is reporting upon an animal's ways and personality is bound by the same obligations of truthfulness as the man who is occupied with the measurements of its skull. By all means let the literary naturalist give us traits instead of measurements. This he is bound to do, and the better

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he does it, the better we shall like him. We can get our statistics elsewhere. From him we want pictures, action, incident, and the portrait of the living animal. But we want it all truthfully done. The life history of any of our wild creatures, the daily and hourly course of its life, all its traits and peculiarities, all its adventures and ways of getting on in the world, are of keen interest to every nature student, but if these things are misrepresented, what then? There are readers, I believe, who say they don't care whether the thing is true or not; at any rate it is interesting, and that is enough. What can one say to such readers? Only that they should not complain if they are *stuck* with paste diamonds, or pinchbeck gold, or shoddy cloth, or counterfeit bills.

The truth of animal life is more interesting than any fiction about it. Can there be any doubt, for instance, that if one knew just how the fur seals find their way back from the vast wilderness of the Pacific Ocean, where there is, apparently, nothing for the eye, or the ear, or the nose to seize upon in guiding them, to the little island in Bering Sea that is their breeding haunt in spring — can there be any doubt, I say, that such knowledge would be vastly more interesting than anything our natural history romancers could invent about it? But it is the way of our romancers to draw upon their invention when their observation fails them. Thus

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one of them tells how the salmon get up the high falls that they meet with in the rivers they ascend in spring — it is by easy stages; they rest upon shelves or upon niches in the rocks behind the curtain of water, and leap from these upward through the pouring current till the top is gained; and he tells it as if he knew it to be a fact, when, in truth, it is a fiction.

Then this so-called individuality of the animals is enormously exaggerated by the nature fakers. The difference between two individuals of the same species in a wild state is but a small matter. What is true of one is practically true of all the others. They are all subject to the same conditions, and the life problems are essentially the same with each; hence their variations are but slight, while in the case of man the variations are enormous. One child is born a genius and another is born a dunce. The mass of mankind would still be sunk in barbarism had it not been for the few superior minds born in every age and country, who have lifted the standard of living and thinking to a higher plane. It is only when the lower animals are brought in contact with man and subjected to artificial conditions that wide diversity of character and disposition appears among them. Then we have on the farm the bucking horse, the intractable ox, the unruly cow, and, in the circus, the trained lion or tiger or elephant that suddenly "goes bad." In domestication the

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difference in the disposition of squirrels, foxes, coons, and other animals comes out, but in the wild state their habits and traits are practically all the same. A fox hunter who knows his territory well will point out to you the course all foxes when pursued by the hounds are very likely to take, generation after generation; the conformation of the land determining the course. Rarely does the fox run wild and upset the calculations of the hunter. But the differences between the behavior of hunted animals under like conditions is not, I think, an evidence of original traits and dispositions in the hunted. One grizzly, or one moose, or one wild boar will charge you when wounded, and another will run away. So will one stick of dynamite explode in the handling while others remain inert; so will one swarm of bees be ugly to-day and docile to-morrow. Slight differences in external conditions, no doubt, determine the result in each case.

I see the herring gulls flying up the river above the floating ice, as I write. Now all those gulls may not be absolutely alike to the last feather, but they are as nearly alike in character as the fragments of floating ice are alike in character. I would not dare affirm any trait or characteristic of one that I would not affirm of all the others. And the score or more of crows perched upon the ice beneath them — what one of those crows will do in its wild state, each and every other crow will or may do. There are no

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geniuses or heroes among them. Hence when our nature fakers claim that they study individuals and not species, they need watching. Let them exploit the individual certainly, but let them be cautious how they claim exceptional traits or intelligence for it.

Let me return to the editors. One of our most influential weekly journals, in defending the nature fakers against the attack of President Roosevelt, makes this statement:—

“We quite agree that fiction ought not to be palmed off on school-children as fact; but we do not agree with what is implied, that imagination may not be used in interpreting and narrating facts. Men see through their temperaments; the imaginative man sees through his imagination, and he is telling the truth if he tells what he sees as he sees it. Mr. Froude, who had a vivid historical imagination, was bitterly condemned by Mr. Freeman, who had none; but Mr. Froude’s history is not only interesting, while Mr. Freeman’s is dull, but very eminent authorities regard him as the better historian of the two.”

Behold what confusion of thought there is in this paragraph. The writer confounds the interpretation of facts with the observation of facts; he confounds the world of ideas with the world of concrete experiences; he confounds the historian of human annals with the eye-witness of daily events in

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the lives of our wild creatures. Neither Froude nor Freeman wrote from observation or experience, as our nature fakers claim to, but from the study of past men and events as recorded by others. They were interpreting the records, and their temperaments and imaginations greatly modified the results. But other things being equal, would we not prefer the historian who kept closest to the record, to the actual facts, of the case? Truthfulness is a merit, imagination is a merit, and neither can take the place of the other. When the two are combined, we get the best results.

Truth in natural history is much easier to reach than truth in civil history. Civil history is vastly more complex. Moreover, it is of the past in a sense that the other is not, and the writers of it are rarely the eye-witnesses of the events they describe; while natural history is being daily and hourly enacted all around us, and varies but little from year to year. A truthful account of the life history of one animal holds substantially correct for all the rest of that species in different places and times. The animal is a part of its environment, and has no independent history in the sense that a man has.

Certainly "the imagination may be used in interpreting and narrating facts" — must be used, if anything of literary value is to be the outcome. But it is one thing to treat your facts with imagination and quite another to imagine your facts. So long

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as the natural historian or the human historian is sound upon his facts, we know where we stand. But the faker is a faker because he disregards the facts. Froude uses more imagination in dealing with his material than Freeman did, hence he has much greater charm and power of style. It is only when he disregards the fact, or takes unwarranted liberties with it, that Freeman can justly criticise him.

There has been no such luminous interpreter of the facts of natural history as Darwin; he read their meaning as no one else had ever before done. His reason and his imagination went hand in hand. But was there ever a mind more loyal to the exact truth? Every man who brought him a fact brought him material for the edifice he was so intent upon building — an edifice which the human mind since his day is dwelling in with more and more contentment.

It is in the interpretation of natural facts and phenomena that temperament, imagination, emotional sensibility, come in play. In all subjective fields — in religion, politics, art, philosophy — one man's truth may be another man's falsehood, but in the actual concrete world of observation and experience, if we all see correctly, we shall all see alike. Blue is blue and red is red, and our color-blindness does not alter the fact. In emotional and imaginative fields a man may be "telling the truth if he tells what he sees as he sees it," but in the field

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of actual observation he is telling the truth only when he tells the thing as it really is, reports the habits and behavior of the animals as they really are. What do we mean by powers of observation but the power to see the thing as it is — to see the truth? An opulent imagination cannot make up for feeble powers of observation. The effect the fact observed has upon you, what you make of it, what it signifies to you — that is another matter. Here interpretation comes in, and on this line you have the field all to yourself. I may think your interpretation absurd, but I shall not question your veracity or honesty of purpose. We are very likely to differ in taste, in opinions about this and that, in religion, politics, art, but we must agree upon facts. Unless there is some chance that men can see and report accurately, what becomes of the value of human testimony as given by eye-witnesses on the witness stand? Things do fall out so and so, or they fall out otherwise; it is not a matter of imagination or of temperament in the beholder, but a matter of accurate seeing. In getting at the value of a man's testimony we may have to take into account his excitable or his phlegmatic temperament and the seductive power of his imagination, and eliminate them as so much dross in a metal. Eye-witnesses generally differ; we must reconcile the differences and sift out the facts.

The animal-story writers, such as Mr. Roberts

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and Mr. Seton, aim to give the charm of art and literature to their natural-history lore; so to work up their facts that they appeal to our emotion and imagination. This is legitimate and a high calling, provided they do not transgress the rule I have been laying down, which Mr. Roberts does when he represents the skunk as advertising his course through the woods to all other creatures by his characteristic odor, since the skunk emits that odor only when attacked, and is at all other times as odorless as a squirrel; or when he says the fox is too cunning to raid the poultry yard near its own door, but will go far off for its plunder. I wish the pair of foxes that had their den within easy rifle-shot of our farmhouse the past season had acted upon this policy. We should have reared more chickens, and one of the foxes would not have met his death in a charge of shot as he did while he was chasing a hen through the currant patch in broad daylight.

The principal aim of the teacher of nature study in the schools should be to help the children to see straight, to develop and sharpen their powers of observation, and to give them rational views of animal mentality.

When one of our nature writers, whose methods have been much criticised, says in the introduction to one of his books on animal life that he would "make nature study more vital and attractive by

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revealing a vast realm of nature outside the realm of science," is not one set to puzzling one's brain as to how there can be any legitimate nature study that will carry one beyond the realm of science? Is there any subject-matter in the books thus prefaced that science cannot deal with? And why does the author aver with such emphasis that his facts are all true and verifiable? — just the test that science demands. If it is all true and sound natural history, what puts it outside the realm of science? If it is not true and real, why call it nature study? Why not call it the gentle art of bearing false witness against the animals? But this realm of nature outside the realm of science — the realm of the occult — is not open to observation, and is therefore not a subject for nature study. The realm of science embraces the whole visible, tangible, and intangible universe. Is not that field enough for nature study? Can there be any other field? What lies outside of this is mere matter of speculation.

The works of the writer referred to are outside the realm of science only as every exaggeration and falsification is outside that realm, or as Alice in Wonderland and Jack and his beanstalk are outside. Such a course may make nature study more attractive to certain credulous minds, but it can hardly make it more vital, or add to our knowledge of the world and its denizens by which we are surrounded.

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II

To see accurately and completely is a power given to few; hence the observations of the majority of people are of no scientific value whatever. One spring I was interested in the question as to how the crow picks up a dead fish or other food from the surface of the water — with its feet or its bill. One would naturally say with its bill, of course, as all except the rapacious birds hold and carry things in their beaks. But one of our younger nature writers made the crow carry food for its young in its claws, and a teacher of zoölogy in a Western academy wrote that he had seen a crow pick up a dead fish from a pond and carry it ashore with its feet. I wrote and cross-questioned the teacher a little; among other things, I asked him if he had the point in question in mind when he saw the crow pick up the fish. As I never received an answer, I concluded that this witness broke down on the cross-examination.

I put the question to fishermen on the river: Had they ever seen a crow pick up anything from the surface of the water? Oh, yes, lots of times. Did he seize the object with his feet or his beak? They would pause and think, and then some would reply, "Indeed, I can't say; I did not notice." One man said emphatically, "With his feet;" another was quite as sure it was done with the bill.

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I myself was sure I had seen crows pick up food from the water, as gulls do, with the bill. I had the vision of that low stooping of the head while the bird was in the act. I asked my son, who spends much time on the river, and who is a keen observer. He had often seen the thing done, but was not certain whether it was with the beak or the feet. A few days later he was on the river, and saw a crow that had spied a fragment of a loaf of bread floating on the water. Having the point in mind, he watched the crow attentively. Down came old crow with extended legs, and my son said to himself, "Yes, he is going to seize it with his feet." But he did not; his legs went down into the water, for what purpose I cannot say, but he seized the bread with his beak, rose up with it and then dropped it, then seized it again in the same way and bore it toward a tree on the shore. Not many days later I saw a crow pick up something from the river in the same way: the feet went into the water, but the object was seized with the beak. The crow's feet are not talons, and are adapted only to perching and walking. So far as I know, all our birds, except birds of prey, carry their food and their nesting-material in their beaks.

One day I saw an eagle flying over with something like a rope dangling from its feet, probably a black snake. A bird carries its capture with the member by which it seizes it, which with birds of prey is the foot, and with other birds the beak. The

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kingfisher lives upon fish, and he always seizes them with his beak and swallows them head foremost.

Any testimony the value of which depends upon accuracy in seeing needs to be well sifted, so few persons see straight and see whole. They see a part, and then guess or fancy the rest. I have read that the Scotch fishermen will tell you that the loon carries its egg under its wing till it hatches. One would say they are in a position to know; their occupations bring them often into the haunts of the loon; yet the notion is entirely erroneous. The loon builds a nest and incubates its eggs upon the ground as surely as does the goose or duck.

Not till the mind is purged of dread, superstition, and all notions of a partnership between the visible and the occult will the eye see straight. The mind that is athirst for the marvelous and the mysterious will rarely see straight. The mind that believes the wild creatures are half human, that they plot and plan and reason as men do, will not see straight, or report the facts without addition or diminution. There is plenty that is curious and inexplicable in nature, things that astonish or baffle us, but there is no "hocus-pocus," nothing that moves on the border-land between the known and the unknown, or that justifies the curious superstitions of the past. Things of the twilight are more elusive and difficult of verification than things of the noon, but they are no less real, and no less a part of the common day.

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I was reminded of this lately on hearing the twilight flight song of the woodcock — one of the most curious and tantalizing yet interesting bird songs we have. I fancy that the persons who hear and recognize it in the April or May twilight are few and far between. I myself have heard it only on three occasions — one season in late March, one season in April, and the last time in the middle of May. It is a voice of ecstatic song coming down from the upper air and through the mist and the darkness — the spirit of the swamp and the marsh climbing heavenward and pouring out its joy in a wild burst of lyric melody; a haunter of the muck and a prober of the mud suddenly transformed into a bird that soars and circles and warbles like a lark hidden or half hidden in the depths of the twilight sky. The passion of the spring has few more pleasing exemplars. The madness of the season, the abandon of the mating instinct, is in every move and note. Ordinarily the woodcock is a very dull, stupid bird, with a look almost idiotic, and is seldom seen except by the sportsman or the tramper along marshy brooks. But for a brief season in his life he is an inspired creature, a winged song that baffles the eye and thrills the ear from the mystic regions of the upper air.

When I last heard it, I was with a companion, and our attention was arrested, as we were skirting the edge of a sloping, rather marshy, boulder-strewn

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field, by the "zeep," "zeep," which the bird utters on the ground, preliminary to its lark-like flight. We paused and listened. The light of day was fast failing; a faint murmur went up from the fields below us that defined itself now and then in the good-night song of some bird. Now it was the lullaby of the song sparrow or the swamp sparrow. Once the tender, ringing, infantile voice of the bush sparrow stood out vividly for a moment on that great background of silence. "Zeep," "zeep," came out of the dimness six or eight rods away. Presently there was a faint, rapid whistling of wings, and my companion said: "There, he is up." The ear could trace his flight, but not the eye. In less than a minute the straining ear failed to catch any sound, and we knew he had reached his climax and was circling. Once we distinctly saw him whirling far above us. Then he was lost in the obscurity, and in a few seconds there rained down upon us the notes of his ecstatic song — a novel kind of hurried, chirping, smacking warble. It was very brief, and when it ceased, we knew the bird was dropping plummet-like to the earth. In half a minute or less his "zeep," "zeep," came up again from the ground. In two or three minutes he repeated his flight and song, and thus kept it up during the half-hour or more that we remained to listen: now a harsh plaint out of the obscurity upon the ground; then a jubilant strain from out the obscurity of the air above. His mate was probably

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somewhere within earshot, and we wondered just how much interest she took in the performance. Was it all for her benefit, or inspired by her presence? I think, rather, it was inspired by the May night, by the springing grass, by the unfolding leaves, by the apple bloom, by the passion of joy and love that thrills through nature at this season. An hour or two before, we had seen the bobolinks in the meadow beating the air with the same excited wing and overflowing with the same ecstasy of song, but their demure, retiring, and indifferent mates were nowhere to be seen. It would seem as if the male bird sang, not to win his mate, but to celebrate the winning, to invoke the young who are not yet born, and to express the joy of love which is at the heart of nature.

When I reached home, I went over the fourteen volumes of Thoreau's Journal to see if he had made any record of having heard the "woodcock's evening hymn," as Emerson calls it. He had not. Evidently he never heard it, which is the more surprising as he was abroad in the fields and marshes and woods at almost all hours in the twenty-four and in all seasons and weathers, making it the business of his life to see and record what was going on in nature.

Thoreau's eye was much more reliable than his ear. He saw straight, but did not always hear straight. For instance, he seems always to have

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confounded the song of the hermit thrush with that of the wood thrush. He records having heard the latter even in April, but never the former. In the Maine woods and on Monadnock it is always the wood thrush which he hears, and never the hermit.

But if Thoreau's ear was sometimes at fault, I do not recall that his eye ever was, while his mind was always honest. He had an instinct for the truth, and while we may admit that the truth he was in quest of in nature was not always scientific truth, or the truth of natural history, but was often the truth of the poet and the mystic, yet he was very careful about his facts; he liked to be able to make an exact statement, to clinch his observations by going again and again to the spot. He never taxes your credulity. He had never been bitten by the mad dog of sensationalism that has bitten certain of our later nature writers.

Thoreau made no effort to humanize the animals. What he aimed mainly to do was to invest his account of them with literary charm, not by imputing to them impossible things, but by describing them in a way impossible to a less poetic nature. The novel and the surprising are not in the act of the bird or beast itself, but in Thoreau's way of telling what it did. To draw upon your imagination for your facts is one thing; to draw upon your imagination in describing what you see is quite another. The new school of nature writers will afford many

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samples of the former method; read Thoreau's description of the wood thrush's song or the bobolink's song, or his account of wild apples, or of his life at Walden Pond, or almost any other bit of his writing, for a sample of the latter. In his best work he uses language in the imaginative way of the poet.

Literature and science do not differ in matters of fact, but in spirit and method. There is no live literature without a play of personality, and there is no exact science without the clear, white light of the understanding. What we want, and have a right to expect, of the literary naturalist is that his statement shall have both truth and charm, but we do not want the charm at the expense of the truth. I may invest the commonest fact I observe in the fields or by the roadside with the air of romance, if I can, but I am not to put the romance in place of the fact. If you romance about the animals, you must do so unequivocally, as Kipling does and as Æsop did; the fiction must declare itself at once, or the work is vicious. To make literature out of natural history observation is not to pervert or distort the facts or to draw the long bow at all; it is to see the facts in their true relations and proportions and with honest emotion.

Truth of seeing and truth of feeling are the main requisite: add truth of style, and the thing is done.

VII

HUMAN TRAITS IN THE ANIMALS

THAT there is a deal of human nature in the lower animals is a very obvious fact; or we may turn the proposition around and say, with equal truth, that there is a deal of animal nature in us humans. If man is of animal origin, as we are now all coming to believe, how could this be otherwise? We are all made of one stuff, the functions of our bodies are practically the same, and the workings of our instincts and our emotional and involuntary natures are in many ways identical. I am not now thinking of any part or lot which the lower orders may have in our intellectual or moral life, a point upon which, as my reader may know, I diverge from the popular conception of these matters, but of the extent in which they share with us the ground or basement story of the house of life — certain fundamental traits, instincts, and blind gropings.

Man is a bundle of instincts, impulses, predilections, race and family affinities, and antagonisms, supplemented by the gift of reason — a gift of which he sometimes makes use. The animal is

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a bundle of instincts, impulses, affinities, appetites, and race traits, without the extra gift of reason.

The animal has sensation, perception, and power of association, and these suffice it. Man has sensation, perception, memory, comparison, ideality, judgment, and the like, which suffice him.

There can be no dispute, I suppose, as to certain emotions and impulses being exclusively human, such as awe, veneration, humility, reverence, self-sacrifice, shame, modesty, and many others that are characteristic of what we call our moral nature. Then there are certain others that we share with our dumb neighbors — curiosity, jealousy, joy, anger, sex love, the maternal and paternal instinct, the instinct of fear, of self-preservation, and so forth.

There is at least one instinct or faculty that the animals have far more fully developed than we have — the homing instinct, which seems to imply a sense of direction that we have not. We have lost it because we have other faculties to take its place, just as we have lost that acute sense of smell that is so marvelously developed in many of the four-footed creatures. It has long been a contention of mine that the animals all possess the knowledge and intelligence which is necessary to their self-preservation and the perpetuity of the species, and that is about all. This homing instinct seems to be one of the special powers that the animals cannot get along without. If the solitary wasp, for instance,

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could not find her way back to that minute spot in the field where her nest is made, a feat quite impossible to you or me, so indistinguishable to our eye is that square inch of ground in which her hole is made; or if the fur seal could not in spring retrace its course to the islands upon which it breeds, through a thousand leagues of pathless sea water, how soon the tribe of each would perish!

The animal is, like the skater, a marvel of skill in one field or element, or in certain fixed conditions, while man's varied but less specialized powers make him at home in many fields. Some of the animals outsee man, outsmell him, outhear him, outrun him, outswim him, because their lives depend more upon these special powers than his does; but he can outwit them all because he has the resourcefulness of reason, and is at home in many different fields. The condor "houses herself with the sky" that she may have a high point of observation for the exercise of that marvelous power of vision. An object in the landscape beneath that would escape the human eye is revealed to the soaring buzzard. It stands these birds in hand to see thus sharply; their dinner depends upon it. If mine depended upon such powers of vision, in the course of time I might come to possess it. I am not certain but that we have lost another power that I suspect the lower animals possess — something analogous to, or identical with, what we call telepathy — power to

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communicate without words, or signs, or signals. There are many things in animal life, such as the precise concert of action among flocks of birds and fishes and insects, and, at times, the unity of impulse among land animals, that give support to the notion that the wild creatures in some way come to share one another's mental or emotional states to a degree and in a way that we know little or nothing of. It seems important to their well-being that they should have such a gift — something to make good to them the want of language and mental concepts, and insure unity of action in the tribe. Their seasonal migrations from one part of the country to another are no doubt the promptings of an inborn instinct called into action in all by the recurrence of the same outward conditions; but the movements of the flock or the school seem to imply a common impulse that is awakened on the instant in each member of the flock. The animals have no systems or methods in the sense that we have, but like conditions with them always awaken like impulses, and unity of action is reached without outward communication.

The lower animals seem to have certain of our foibles, and antagonisms, and unreasoning petulancies. I was reminded of this in reading the story President Roosevelt tells of a Colorado bear he once watched at close quarters. The bear was fussing around a carcass of a deer, preparatory to burying

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it "Once the bear lost his grip and rolled over during the course of some movement, and this made him angry and he struck the carcass a savage whack, just as a pettish child will strike a table against which it has knocked itself." Who does not recognize that trait in himself: the disposition to vent one's anger upon inanimate things — upon his hat, for instance, when the wind snatches it off his head and drops it in the mud or leads him a chase for it across the street; or upon the stick that tripped him up, or the beam against which he bumped his head? We do not all carry our anger so far as did a little three-year-old maiden I heard of, who, on tripping over the rockers of her chair, promptly picked herself up, and carrying the chair to a closet, pushed it in and spitefully shut the door on it, leaving it alone in the dark to repent its wrong-doing.

Our blind, unreasoning animal anger is excited by whatever opposes or baffles us. Of course, when we yield to the anger, we do not act as reasonable beings, but as the unreasoning animals. It is hard for one to control this feeling when the opposition comes from some living creature, as a balky horse or a kicking cow, or a pig that will not be driven through the open gate. When I was a boy, I once saw one of my uncles kick a hive of bees off the stand and halfway across the yard, because the bees stung him when he was about to "take them

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up." I confess to a fair share of this petulant, unreasoning animal or human trait, whichever it may be, myself. It is difficult for me to refrain from jumping upon my hat when, in my pursuit of it across the street, it has escaped me two or three times just as I was about to put my hand upon it, and as for a balky horse or a kicking cow, I never could trust myself to deal reasonably with them. Follow this feeling back a few thousand years, and we reach the time when our forbears looked upon all the forces in nature as in league against them. The anger of the gods as shown in storms and winds and pestilence and defeat is a phase of the same feeling. A wild animal caught in a steel trap vents its wrath upon the bushes and sticks and trees and rocks within its reach. Something is to blame, something baffles it and gives it pain, and its teeth and claws seek every near object. Of course it is a blind manifestation of the instinct of self-defense, just as was my uncle's act when he kicked over his beehive, or as is the angler's impatience when his line gets tangled and his hook gets fast. If the Colorado bear caught his fish with a hook and line, how many times would he lose his temper during the day!

I do not think many animals show their kinship to us by exhibiting the trait I am here discussing. Probably birds do not show it at all. I have seen a nest-building robin baffled and delayed, day after day, by the wind that swept away the straws and

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rubbish she carried to the top of a timber under my porch. But she did not seem to lose her temper. She did not spitefully reclaim the straws and strings that would persist in falling to the porch floors, but cheerfully went away in search of more. So I have seen a wood thrush time after time carrying the same piece of paper to a branch from which the breeze dislodged it, without any evidence of impatience. It is true that when a string or a horsehair which a bird is carrying to its nest gets caught in a branch, the bird tugs at it again and again to free it from entanglement, but I have never seen any evidence of impatience or spite against branch or string, as would be pretty sure to be the case did my string show such a spirit of perversity. Why your dog bites the stone which you roll for him when he has found it, or gnaws the stick you throw, is not quite clear, unless it be from the instinct of his primitive ancestors to bite and kill the game run down in the chase. Or is the dog trying to punish the stick or stone because it will not roll or fly for him? The dog is often quick to resent a kick, be it from man or beast, but I have never known him to show anger at the door that slammed to and hit him. Probably, if the door held him by his tail or his limb, it would quickly receive the imprint of his teeth.

In reading Bostock on the "Training of Wild Animals," my attention was arrested by the remark

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that his performing lions and tigers are liable to suffer from "stage fright," like ordinary mortals, but that "once thoroughly accustomed to the stage, they seem to find in it a sort of intoxication well known to a species higher in the order of nature;" and furthermore, that "nearly all trainers assert that animals are affected by the attitude of an audience, that they are stimulated by the applause of an enthusiastic house, and perform indifferently before a cold audience." If all this is not mere fancy, but is really a fact capable of verification, it shows another human trait in animals that one would not expect to find there. Bears seem to show more human nature than most other animals. Bostock says that they evidently love to show off before an audience: "The conceit and good opinion of themselves, which some performing bears have, is absolutely ridiculous." A trainer once trained a young bear to climb a ladder and set free the American flag, and so proud did the bear become of his accomplishment, that whenever any one was looking on he would go through the whole performance by himself, "evidently simply for the pleasure of doing it." Of course there is room for much fancy here on the part of the spectator, but bears are in so many ways — in their play, in their boxing, in their walking — such grotesque parodies of man, that one is induced to accept the trainer's statements as containing a measure of truth.

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The preëminent danger of the animal trainer comes under the same conditions that it would probably come to him were he a trainer of wild men, to wit, when he stumbles or falls. In such a case, the lion or tiger is very apt to spring upon him. These beasts seem to know that a man is less formidable when down than when standing; when prone upon the ground, his power has departed. They also, like the human savage, often seize the opportunity for an attack upon him when his back is turned. A bold, threatening front cows an animal as it cows a man. The least sign of fear or of hesitation on the part of the trainer, and he is in danger. Self-confidence, self-control, an authoritative manner, count for just as much in our dealing with the animals as with men. How a bold, unhesitating manner will carry you through a pack of threatening dogs, while timidity or parleying endangers your calves! Act as though you were the rightful master of the place and had come to give orders, and the most threatening watch-dog gives way. Flee from a mad bull, a cross dog, a butting sheep, and your danger is vastly increased. Even an insolent rooster or a bellicose gander will strike you then. I have found that the best way to deal with the hive bee is by a bold and decisive manner. I would even recommend the same course with yellow-jackets; if you are bent on demolishing their nest, do it by a sudden bold stroke, and not by timid approaches.

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All kinds of bees seem disconcerted by a sudden onslaught.

Another human trait that seems almost universal among the lower animals is the coyness and reluctance of the female in her relations to the male. Her first impulse is to refuse and to flee. She is negative as the male is positive. Among the birds there is something like regular courtship, there is rivalry and jealousy and hostile collision on the part of both sexes. With the birds, the propagating instinct in the female is evidently not subject to the same law of recurring intervals that it is among mammals. Hence the female must be stimulated and won by the male. He addresses himself to her in a way that is quite exceptional, if it occurs at all, among mammals. His aim seems to be to kindle or quicken her sexual and mating impulses. In the case of mammals, these impulses recur at certain periods, and no courtship on the part of the male is necessary.

Just what part the gay plumes and the extra appendages of the males play in bird courtship I have discussed elsewhere. I think it is highly probable that the bright colors and ornamental plumes of the male react upon him, excite him, and increase his pride, his courage, and the impetuosity of his address. The birds that dance and perform before the females, during the breeding season, seem to show more and more excitement as the dance proceeds, apparently intoxicated by their own ardor. Just

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what determines the choice of the male and sets him in pursuit of a particular female is a question that greatly interests me. Does the matter turn upon some complementary variation too subtle for us to perceive? The mating of birds certainly seems like an act of choice; but just what determines it, how shall we find that out? Behold the sparrows in the street, three or four males apparently in a scrimmage with one female, surrounding her and playfully assaulting her, with spread plumage and animated chirping and chattering, while she, the centre of the group, strikes right and left, in a serious, angry mood, at her would-be suitors. What does it mean? Or, the robins in the spring, rushing across the lawn and forming sudden rough-and-tumble groups with a struggling and indignant female in the centre, or gleefully screaming, and quickly and apparently amicably separating? In all such cases the hen bird alone wears an angry and insulted air. What indignity has been put upon her? I know of nothing in human courtship analogous to this tumultuous and hilarious pursuit of the females by the cock sparrows and robins.

The gregarious instinct of birds and mammals does not differ essentially, as I see, from the same instinct in man, except that in man it is often for coöperation or mutual protection, while with the lower animals it seems purely social. Many birds flock in the fall and winter that live in pairs during

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the summer. Crows, for instance, have their rookeries, where vast numbers congregate to pass the winter nights, and they usually keep in bands or loose flocks during the winter days. Apparently, this clannishness in winter is for social cheer and good-fellowship alone. As they roost in naked, exposed treetops, they could not, it seems to me, perceptibly shield one another from the cold; while it is reasonable to think that the greater scarcity of food at this season would naturally cause them to scatter. But the centripetal force, so to speak, of the social instinct, triumphs over all else. Many species of our birds flock in the fall — the various blackbirds, the cedar-birds, the goldfinches, the siskins, the snowbirds, the tree and bank swallows, to say nothing of the waterfowl — some to migrate and some to pass the winter here. In similar conditions or similar stress of circumstances, human beings would probably act in a similar way; we should migrate in herds, or face some common calamity in large aggregates.

Indeed, the social instinct seems radically the same in all forms of animal life. The loneliness of a domestic animal separated from the herd, the homesickness of a dog or a horse when removed to a strange place, do not seem to differ very much from the feelings we experience under like circumstances. Attachment to places, attachment to persons, attachment to one another, to home and to

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mate — these feelings seem about the same in kind among all creatures. Of course they are more complex, far-reaching, and abiding in man than in the animals below him, but their genesis seems the same.

Among both birds and four-footed beasts, the maternal affection is doubtless greater than the paternal, and this also is human. But how brief and fugitive the affection is, compared with the same attachment in our own species! — of a few weeks' duration among our common birds, and a few months or a year among the mammals, but always as long as the well-being of the young requires it. When they become self-supporting, the parental affection ceases. And in a limited sense this is true in our own case.

If a bird loses its mate during the breeding season, the period of mourning and waiting is very brief, usually not more than a day or two. The need of rearing a family is urgent, and nature wastes no time in unavailing regrets. Just how the bereaved mate makes her or his wants known, I never could find out; but it seems there are always not far off some unmated birds of both sexes that are ready to step in and complete the circle once more. From sparrows to eagles, this seems to be the rule.

With what species, if any, the marriage unions last during life, I do not know. Neither do I know

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if anything like divorce, or unfaithfulness, or free love, ever takes place among the monogamous birds — probably not. The riot of the breeding instinct in the males confines itself to gay plumes, or songs, or grotesque antics, while the seriousness and preoccupation of the female, I doubt not, would prove an effectual warning to any gay Lothario among her neighbors, if such there happened to be.

I am convinced that birds have a sense of home, or something analogous to it, and that they return year after year to the same localities to nest. The few cases where I have been able to identify the particular sparrow or robin or bluebird confirm me in this belief.

Hermits among the birds or beasts are probably very rare, and I doubt if voluntary seclusion ever occurs. Sometimes an old male, vanquished and in a measure disabled by his younger rivals, may be driven out of the herd or pack and compelled to spend the remainder of his days in comparative solitude. Or an old eagle that has lost its mate may spend its days henceforth alone. The birds of prey, like the animals of prey, and like prowlers and bloodsuckers generally, are solitary in their habits.

The feeling of hostility towards strangers that all animals manifest in varying degrees, how distinctly we can trace it up through the savage races and through the lower orders of our social aggre-

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gates, till it quite fades out in the more highly civilized communities!

Animals experience grief over the loss of their young, but not over the death of a member of their flock or tribe. Death itself seems to have no meaning to them. When a bird seems to mourn for its lost mate, its act is probably the outcry of the breeding instinct which has been thwarted.

Do the birds and mammals sympathize with one another? When one bird utters a cry of distress, the birds of other species within hearing will hasten to the spot and join in the cry — at least in the breeding season. I have no proof that they will do it at other times. And I do not call this sympathy, but simply the alarm of the parental instinct, which at this season is very sensitive. The alarm-cry of many birds will often put four-footed animals on the lookout. The language of distress and alarm is a universal language, which all creatures understand more or less. But I doubt if sympathy as we know it — the keen appreciation of the suffering or the misfortune of another, which implies power in a measure to put ourselves in that other's place — even in its rudimentary form, exists among the lower orders. Among the domestic fowls, a cry of distress from one of them usually alarms the others: a cry from a chicken brings the mother hen to the rescue; this is the maternal instinct, and the instinct of self-preservation which all animals must have or

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their race would perish. A certain agonized call from a member of a herd of cattle will at once bring the other members to the spot, with uplifted heads and threatening horns. This, again, is the instinct of self-preservation. This, I say, animals must have, but they do not have to have sympathy any more than they have to have veneration, or humility, or the æsthetic sense. But fear — think how important this is to them — blind, unreasoning fear, but always alert and suspicious.

Fear in the human species is undoubtedly of animal origin. How acute it often is in young children — the fear of the dark, of the big, of the strange, and of the unusual! The first fear I myself remember was that of an open door at night leading into a dark room. What a horror I felt at that mysterious cavernous darkness! — and this without any idea of the danger that might lurk there. The next fear I recall was a kind of panic, when I was probably three or four years of age, at the sight of a hawk sailing against the sky above me. I hurriedly climbed over the wall and hid behind it. Later, when I was ten or twelve years of age, my fear took a less animal form — a fear of spooks and hobgoblins, induced, no doubt, by the fearsome superstitions of my elders. Now I am not conscious of any physical or superstitious fears, but there is plenty of moral cowardice left. My little granddaughter, when two and a half years old, was

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filled with terror of the sea as she saw it for the first time from the beach.

Fear seems to have the same effect upon both man and beast, causing trembling of the muscles, a rapid beating of the heart, a relaxation of the sphincters, momentary weakness, confusion, panic, flight. It would be interesting to know if the blood leaves the capillaries in the faces of animals during sudden fright, as it does in man, producing paleness.

The panic that sometimes seizes a multitude of animals, resulting in a stampede, a blind, furious rush away from the real or the imaginary danger, seems to differ but little from that which at times seizes the human multitude in theatre, or circus, or on the field of battle. It is a kind of madness, augmented and intensified by numbers. The contagion of fear works among all creatures, like the contagion of joy, or anger, or any other sudden impulse. These things are "catching;" an emotional state in one man or one animal tends to beget the same state in all other near-by men or animals, either through imitation, or through some psychic law not well understood. Like begets like throughout nature. Just as our bodily temperature rises in a crowd, so does that psychic state become more acute in which we are liable to sudden enthusiasms or panic, fear or animal cruelty. Mobs are guilty of things, especially in the way of violence, that the separate members of them would never think of

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doing, just as nations and corporations will exhibit a meanness and hoggishness that would shame the individuals composing them.

It is a question whether or not the lower animals ever experience the feeling we know as revenge — that they cherish a hatred or a secret enmity toward one of their own kind or toward a person, in the absence of that person or fellow. Their power of association, which is undoubted, would call up the old anger on the sight of an object that had injured them, but they probably do not in the meantime carry any feeling of ill-will as we do, because they do not form mental concepts. And yet I have known things to happen that point that way. It is well known that the blue jay destroys the eggs of other birds. One day I found a nest of a blue jay with its five eggs freshly punctured — each egg with a small hole in it as if made by the beak of a small bird, as it doubtless had been. Was this revenge on the part of some victim of the jay's? One can only conjecture. Roosevelt tells this curiously human anecdote of a bear. A female grizzly was found by a hunter lying across a game trail in the woods. The hunter shot the bear as she was about to charge him, and on examining the spot where she had been lying, he found that it was the freshly made grave of her cub. He conjectured that a male grizzly or a cougar had killed the cub in the absence of the mother, and that on her return she had buried it,

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and had lain down upon the grave waiting to wreak her vengeance upon the murderer of her young. But this may be only the plausible human interpretation of the fact. Just what the bear's state of mind was, we have no means of knowing.

The dog undoubtedly exhibits more human traits than any other lower animal, and this by reason of his long association with man. There are few of our ordinary emotions that the dog does not share, as joy, fun, love of adventure, jealousy, suspicion, comradeship, helpfulness, guilt, covetousness, and the like, or feelings analogous to these — the dog version of them. I am not sure but that the dog is capable of contempt. The behavior at times of a large dog toward a small, the slights he will put upon him, even ejecting his urine upon him, is hardly capable of any other interpretation. The forbearance, too, which a large dog usually shows toward a touchy little whiffet, never resenting its impudent attacks, is very human. "A barking dog never bites" is an old saying founded upon human nature as well as upon dog nature. The noisy blusterer is rarely dangerous, whether man or dog. I do not agree with Stevenson that the dog is a snob. The key to a dog's heart is kindness. He will always meet you halfway and more. I have been asked why the farm dog usually shows such hostility to tramps and all disreputable-looking persons. It is not their looks that disturb the dog, but

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their smell — a strange, unknown odor. This at once puts him on his guard and excites his enmity. There is little speculation in the eye of a dog, but his nose is keen and analytical.

The dog, through his long intercourse with man, has become charged with our human quality, as steel is charged by a magnet. Yet I am told that a tame wolf or a tame fox fawns and wags his tail and tries to lick his master's face, the same as the dog. At any rate, the dog does many things that we can name only in terms applicable to ourselves. My dog coaxes me to go for a walk, he coaxes me to get upon my lap, he coaxes for the food I am eating. When I upbraid him, he looks repentant and humiliated. When I whip him, he cries, when I praise him, he bounds, when I greet him in the morning, he whines with joy. It is not the words that count with him, it is the tone of the voice.

When I start out for a walk, he waits and dances about till he sees which way I am going. It seems as if he must at such times have some sort of mental process similar to my own under like circumstances. Or is his whole behavior automatic — his attitude of eagerness, expectancy, inquiry, and all? as automatic as the wagging of his tail when he is pleased, or as his bristling up when he is angry? It evinces some sort of mental action, but the nature of it is hard to divine. When he sits looking vaguely out upon the landscape, or rests his chin upon his paws

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and gazes into the fire, I wish I knew if there were anything like currents of thought, or reminiscences, or anticipations passing through his mind. When I speak sternly to him and he cowers down or throws himself on his back and puts up his paws pleadingly, I wish I knew just the state of his mind then. One day my dog deserted me while I was hunting, and when I returned, and before I had spoken a word to him, he came creeping up to me in the most abject way, threw himself over, and put up his pleading paws, as if begging forgiveness. Was he? We should call it that in a person. Yet I remember that I upbraided him when he first showed the inclination to desert me, and that fact may account for his subsequent behavior.

When you speak to your dog in a certain way, why does he come up to you and put out his front legs and stretch, and then stretch his hind legs, and maybe open his mouth and gape? Is it an affectation, or a little embarrassment because he does not know what you are saying? All dogs do it. The human traits of the dog are very obvious. One time I drove many miles through the country with my small mongrel black and tan dog Lark with me, often on the seat by my side. When he was in the wagon and other dogs came out and barked at us, Lark was very brave and answered back defiantly and threateningly; but when he was upon the ground and other dogs came out, Lark was as meek

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and non-resisting as a Quaker. Then let me take him up out of harm's way, and see how his tone would change, and what a setting-out he would give those dogs!

I do not believe that animals ever commit suicide. I do not believe that they have any notions of death, or take any note of time, or ever put up any "bluff game," or ever deliberate together, or form plans, or forecast the seasons. They may practice deception, as when a bird feigns lameness or paralysis to decoy you away from her nest, but this of course is instinctive and not conscious deception. There is on occasion something that suggests coöperation among them, as when wolves hunt in relays, as they are said to do, or when they hunt in couples, one engaging the quarry in front, while the other assaults it from the rear; or when quail roost upon the ground in a ring, their tails to the centre, their heads outward; or when cattle or horses form a circle when attacked in the open by wild beasts, the cattle with their heads outward, and the horses with their heels. Of course all this is instinctive, and not the result of deliberation. The horse always turns his tail to the storm as well, and cows and steers, if I remember rightly, turn their heads.

A family of beavers work together in building their dam, but whether or not they combine their strength upon any one object and thus achieve unitedly what they could not singly, I do not know.

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Of course among the bees there is coöperation and division of labor, but how much conscious intelligence enters into the matter is beyond finding out.

Leadership among the animals, when it occurs, as among savage tribes, usually falls to the strong, to the most capable. And such leaders are self-elected: there is nothing like a democracy in the animal world. Troops of wild horses are said always to have a leader, and it is probable that bands of elk and reindeer do also. Flocks of migrating geese and swans are supposed to be led by the strongest old males; but among our flocking small birds I have never been able to discover anything like leadership. The whole flock acts as a unit, and performs its astonishing evolutions without leaders or signals.

In my youth, upon the farm, I observed that in a dairy of cows there was always one master cow, one to whose authoritative sniff, or gesture, or thrust, all others yielded, and she was usually the most quiet and peaceful cow in the herd.

The male animal, as compared with the female, is usually the more aggressive and domineering, except among birds of prey, where the reverse is true. Roosevelt says that a band of antelope, as of elk and deer, is ordinarily led by an old doe, but that when danger threatens, a buck may spring to the leadership.

In the breeding season the pronghorn buck has

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his harems — all the does he can steal or cajole or capture from his rivals. "I have seen a comparatively young buck," says Roosevelt, "who had appropriated a doe, hustle her hastily out of the country as soon as he saw another antelope in the neighborhood; while on the other hand, a big buck, already with a good herd of does, will do his best to appropriate any other that comes in sight."

On the seal islands of Alaska we saw many old bull seals with their harems about them — a dozen or more demure-looking females resting upon low boulders, while their lord and master sat perched above them on a higher rock. The defeated males, too young or too old to hold their own against their rivals, hung in ill-humored dejection about the neighborhood. I have read that on the Pampas in South America, wild stallions will capture and hurry away domestic mares, if they have a chance.

Animals are undoubtedly capable of feeling what we call worry and anxiety just as distinctly as they feel alarm or joy, only, of course, these emotions are much more complex in man. How the mother bird seems to worry as you near her nest or her young; how uneasy the cow is when separated from her calf, or the dog when he has lost his master! Do these dumb kindred of ours experience doubts and longings and suspicions and disappointments and hopes deferred just as we do? — the same in kind, if not in degree?

HUMAN TRAITS IN THE ANIMALS

The sheer agony or terror which an animal is capable of feeling always excites our pity. Roosevelt tells of once coming upon a deer in snow so deep that its efforts to flee were fruitless. As he came alongside of it, of course to pass it by untouched, it fell over on its side and bleated in terror. When John Muir and his dog Stickeen, at the imminent peril of their lives, at last got over that terrible crevasse in the Alaska glacier, the dog's demonstrations of joy were very touching. He raced and bounded and cut capers and barked and felicitated himself and his master as only a dog can.

The play of animals seems strictly analogous to the play of man, and I have no doubt that the reason of the one, whatever that be, is the reason of the other. Whether play is to be accounted for upon the theory of surplus energy, as Spencer maintains, or upon the theory of instinctive training and development — a sort of natural, spontaneous school or kindergarten that has reference to the future wants of the animal, as the German psychologist Karl Groos argues — a biological conception of play — its genesis is no doubt the same both in man and beast. The main difference is that the play of one is aimless and haphazard, while that of the other has method and purpose. Animals have no rules or systems, and yet I have often seen two red squirrels engaged in what seemed precisely analogous to the boys' game of tag. Up and down and

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from tree to tree they would go, until one of them overtook the other, when it seemed to become its turn to flee and be pursued. But just how much method there is in such a game, it is impossible to determine. In all cases, the play of animals tends to develop those powers of speed, or agility, or strength that their ways of living call for. The spirit of play gradually leaves an animal at maturity, as it leaves man.

A trait alike common to man and beast is imitateness; both are naturally inclined to 'do what they see their fellows do. The younger children imitate the elder, the elder imitate their parents, their parents imitate their neighbors. The young writer imitates the old, the young artist copies the master. We catch the trick of speech or the accent of those we much associate with; we probably, in a measure, even catch their looks. Any fashion of dress or equipage is as catching as the measles. We are more or less copyists all our lives. Among the animals, the young do what they see their parents do; this, I am convinced, is all there is of parental instruction among them; the young unconsciously follow the example of their elders. The bird learns the song of its parent. If it never hears this song, it may develop a song of its own—like its parent's song in quality, of course, but unlike it in form. Or it may acquire the song of some other species.

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Darwin thinks that birds have "nearly the same taste for the beautiful as we have," except, of course, that in man "the sense of beauty is manifestly a more complex feeling and is associated with various intellectual ideas." It seems to me that if we mean by taste the appreciation of the beautiful, it is as distinctly a human gift as reason is, or as is the sense of humor, or the perception of the spiritual and the ideal. Shall we say the lilies of the field have taste because Solomon in all his glory was not arrayed like one of these? or that the trees have taste because of their grace and beauty of form? or the insects because of their many beautiful colors and patterns? I doubt if the æsthetic feeling is even rudimentary in birds, any more than are our moral and other intellectual traits. It is thought that the male bird sings to charm the female. Are such discordant notes, then, as the gobble of the turkey, the crowing of the cock, the scream of the peacock or of the guinea hen, to charm the female? When the rooster crows, the nearby hens shake their heads as if the sound pained them, as doubtless it does.

Why, then, do birds sing? Is it from a love of beautiful sounds? I can only answer that it seems to be a trait inherent in the male sexual principle, as much so as are gay plumes and ornamental appendages; it is one of the secondary sexual characteristics. It is very significant that the sweetest

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songsters to our ears are, as a rule, of the plainest colors and free from extra plumes and ornaments. I have yet to discover any evidence of pleasure on the part of the female in the songs of her male suitors. The male does not even sing for his own ear; if he did, when his vocal powers are defective, as is sometimes the case, he would quit singing. But such is not the case; he sings because he has the impulse to sing, and that is reason enough.

I know but one fact in the life of our birds that suggests anything like taste. I refer to the nesting-habits of the hummingbird, and of the little blue-gray gnatcatcher and the wood pewee. The nests of these birds are always neatly thatched with lichens, thus perfectly realizing the dream of the true domestic architect, of making the structure blend with its surroundings. The nests of nearly all birds blend well with their surroundings, because the material at hand is itself of a dull, neutral character. But the lichens which the hummer and the gnatcatcher and our wood pewee use seem, at first sight, an extra touch. Yet I cannot credit it to taste or to the love of the beautiful, because it is beautiful only to the cultivated, artistic taste of man. To a savage, or even to those much higher in civilization, it would not appear beautiful. A certain degree of culture has to be reached before we find beauty in these quieter things. The reason why these birds thatch the outside of their nests with lichens is

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doubtless this: the nests are built of a kind of down that would render them very frail and pervious to the rain were they not stayed and thatched with some firmer material. The lichens and spiders' webs bind them together and keep them in shape. Hence I should say that utility alone governed the bird in this use of lichens. Bright objects attract children, attract birds, attract quadrupeds, but this attraction is far enough from what we mean by taste or the love of the beautiful.

VIII

ANIMAL AND PLANT INTELLIGENCE

I

WHEN I hear a person expatiating on the reasoning powers of the lower animals, as I very often do, I want to tell him of the wonderful reasoning powers of the flies that pester our cow in summer. Those flies have measured the length of the old cow's tail so accurately that they know the precise spot on her body where the tail cannot reach them; on these spots they settle and torment her. Their behavior reveals great powers of calculation and reasoning. By what means they measured the swing of that tail so accurately I do not know. When I come slying up with a switch in my hand, they dart away before I can get in a stroke, because they know I can reach them; they take the measure of my arm and switch on the instant — on the fly, as it were. And what shall we say of the mosquito that so quickly finds out the vulnerable parts of one's clothing? If one chances to be wearing low shoes, does she not know at a glance where to strike, though she may never have seen low shoes before?

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Now is not that reasoning just as good as much of the reasoning that the public indulges in upon these subjects? Or, take the wit of the old cow herself. Yonder is a very steep hillside, the high, abrupt bank of an old river terrace. Along this bank the cattle have made a series of parallel paths, level as the top of the terrace itself. The paths, I should think, are about four feet apart, just far enough so that the cow walking along one of them can graze at her ease over all the strip of ground that lies between it and the next path. When she comes to the end, she steps up into the path above and repeats the process, and so on till the whole side of the terrace has been grazed over. Does not this show that the cow is very level-headed, that she can meet a difficult problem and solve it as rationally as you or I? Without the paths, how awkward and difficult the grazing would be! Now it is done easily because it is done from level paths; it is done thoroughly because it is done systematically. If you or I were going to search that hillside over daily, should not we adopt similar or identical tactics?

In Idaho I saw that the grazing sheep had terraced the grassy mountain-sides in the same way. Their level paths were visible from afar. How inevitable and free from calculation it all is! The grazing cattle take the easiest way, and this way is horizontally along the face of the hill. To take the

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hill by a straight climb or diagonally would be labor, so the animal moves easily along its side, cropping the grass within reach. Then she takes a step or two upward and grazes back the other way, and this process is repeated till a series of level parallel paths are worn in the side of the hill. They are as much a natural result as is the river terrace itself.

The cow has always been a famous engineer in laying out paths; sheep are, too. They take the line of least resistance; they ford the streams at the best places; they cross the mountains in the deep notches; they scale the hills by the easiest grade. Shall we, therefore, credit them with reason?

When I was a bucolic treasury clerk in Washington, the cow of an old Irishwoman near by used to peep through the cracks in my garden fence at my growing corn and cabbage till her mouth watered. Then she saw that a place in the fence yielded to me and let me in, so she tried it; she nudged the gate with her nose until she hit the latch, and the gate swung open by its own weight and let her in. There was an audible crunching of succulent leaves and stalks that soon attracted my attention. I hustled her out, and sent a kick after her that fell short and nearly unjointed my leg. But she was soon back, and she came again and again till I discovered her secret and repaired the latch so that nudging or

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butting the gate would not open it. How surely such conduct as this of the cow's evinces reason to most persons! But shall we not rather call it the blind gropings of instinct stimulated into action by the sight and odor of the tender vegetables? Many of the lowest organisms show just as much intelligence about their food as did the old cow. Even the American sundew, according to Mrs. Treat, will move its leaves so that it can seize a fly pinned half an inch from it. The method of the old cow was that of hit and miss, or trial and error. She wanted the corn, and she butted the gate, and as luck would have it, when she hit the latch the gate swung open. But shall we conclude that the beast had any idea of the principle of the gate? Or any idea at all but the sense impression made upon her hunger by the growing vegetables? Animals do not connect cause and effect as we do by thinking the "therefore;" they simply associate one thing with another. Your dog learns to associate your act of taking your hat and cane with a walk, or your gun with the delights of the chase, or with its report, if he is afraid of it, and so on. Without this power of association the birds and beasts could not get on in life; the continuity of their experience would be broken. It is a rude kind of memory — sense memory. A sense impression to-day revives a sense impression of yesterday, or of the day before, and that is about all there is of it.

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While I am telling tales on old Brindle, let me mention another point. Most farmers and country people think that the "giving down" or "holding up" of the milk by the cow is a voluntary act. In fact, they fancy that the udder is a vessel filled with milk, and that the cow releases it or withholds it just as she chooses. But the udder is a manufactory; it is filled with blood, from which the milk is manufactured while you milk. This process is controlled by the cow's nervous system. When she is excited or in any way disturbed, as by a stranger, or by the taking away of her calf, or any other cause, the process is arrested and the milk will not flow. The nervous energy goes elsewhere. The whole process is as involuntary as is digestion in man, and is disturbed or arrested in about the same way.

Why should we not credit the child with reason when it is learning to walk, and with a knowledge of the law of gravity? See how carefully it poises itself on the feet and adjusts itself to the pull of the invisible force. It is a natural philosopher from the cradle, and knows all about the necessity of keeping the centre of gravity within the base if it would avoid a fall! But there is probably less calculation in all this than there appears to be, since Huxley tells us that a frog with most of its brain removed will keep its position on the top of the hand while you slowly turn it over. It, too, feels the pull of gravity and knows all about the impor-

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tance of keeping the centre within the base. Throw this brainless frog into the water, and it swims as well as ever it did. Dan Beard, in his delightful "Animal Book," says that a rattlesnake which had just had its head cut off, coiled and struck him with the bloody stump when he touched it as promptly as it would have done with its head on. So it is doubtless true that all creatures do many reasonable and natural things without possessing the faculty of reason. Much of our own conduct in life is the result of this same unconscious, unreasoning obedience to natural forces or innate tendencies.

The English psychologist Hobhouse gives an account, in his work on "Mind and Evolution," of the experiments he tried with cats, dogs, monkeys, an otter, and an elephant, to test their intelligence. Their food was placed in boxes or jars, or tied to a string, in such ways that to get at it the animal had to do certain definite concrete things that it could not have been called upon to do in the ordinary course of its natural life, such as pulling strings, working levers, drawing bolts, lifting latches, opening drawers, upsetting jugs, always stimulated by the prospect of food. After many trials at the various tricks, a little gleam of intelligence seemed to pass through their minds. It was as if a man without power to move should finally feebly lift a hand or shake his head. The elephant was taught to pull a bolt and open the lid

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of a box only by her keeper taking her trunk in his hand and guiding it through each movement, stage by stage. She learned to pull the bolt on the seventh trial, but could not learn the three movements of drawing bolt, opening lid, and holding it open, till the fortieth trial, on the third day. Sometimes she tried to lift the lid before she drew the bolt, sometimes she pushed the bolt the wrong way. Another elephant learned to draw the bolt on the fourth trial. The otter learned to draw the bolt after seeing it drawn twelve times. Jack, the dog, learned to do the trick in his pawing, blundering way after many trials. A bolt furnished with a knob so that it could not be drawn all the way out worried all the animals a good deal. The dog had ninety lessons, and yet did not clearly understand the trick. The monkeys and the chimpanzee learned the different tricks more readily than the other animals, but there "appeared to be no essential difference in capacity to learn between the dogs, the elephants, the cats, and others." None of the animals seemed to appreciate the point of the trick, the dependence of one thing upon another, or the *why* of any particular movement. Poor things! their strenuous intellectual efforts in drawing a bolt or working a lever used to tire them very much. Sometimes, under the tutelage of their trainers, they would seem to show a gleam of real intelligence, as when you fan a dull ember till it glows a little. The

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next hour or the next day the ember had lost its glow and had to be fanned again. Yet they all did improve in doing their little "stunts," but how much was awakened intelligence, and how much mere force of habit, one could not be quite sure.

Hobhouse is no doubt right when he says that intelligence arises within the sphere of instinct, and that the former often modifies the action of the latter. The extent to which the lower animals profit by experience is a measure of their intelligence. If they hit upon new and improved ways spontaneously, or adapt new means to an end, they show a measure of intelligence. I once stopped up the entrance to a black hornets' nest with cotton. The hornets removed the cotton by chewing off the fibres that held it to the nest, and then proceeded to change the entrance by carrying it farther around toward the wall of the house, so that the feat of stopping it up was not so easy. Was this an act of intelligence, or only an evidence of the plasticity or resourcefulness of instinct? But if a dog in stalking a woodchuck (and I have been told of such things) at the critical moment were to rush to the woodchuck's hole so as to get there before it, this were an act of intelligence. To hunt and stalk is instinctive in the dog, but to correlate its act to that of its prey in this manner would show the triumph of intelligence over instinct.

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II

Huxley thought that because of the absence of language the brutes can have no trains of thought but only trains of feeling, and this is the opinion of most comparative psychologists. I am myself quite ready to admit that the lower animals come as near to reasoning as they come to having a language. Their various cries and calls — the call to the mate, to the young, the cry of anger, of fear, of alarm, of pain, of joy — do serve as the medium of some sort of communication, but they do not stand for ideas or mental concepts any more than the various cries of a child do. They are the result of simple reactions to outward objects or to inward wants, and do not imply any mental process whatever. A grown person may utter a cry of pain or fear or pleasure with a mind utterly blank of any ideas. Once on a moonlight night I lay in wait for some boy poachers in my vineyard. As I suddenly rose up, clad in a long black cloak, and rushed for one and seized his leg as he was hastening over the fence, he uttered a wild, agonized scream precisely as a wild animal does when suddenly seized. He told me afterward that he was fairly frightened out of his wits. For the moment he was simply an unreasoning animal.

A language has to be learned, but the animals all use their various calls and cries instinctively.

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What a clear case is that of the hen when she brings off her first brood! She speaks a language which she never spoke before, and her chickens hear a language which they never heard before, and understand it instantly. When the mother hen calls them, they come; when she utters her alarm-note, they hide, or run to her for protection.

The various calls and cries of the animals have just about the same significance as do their gestures of bristling, arching, pawing, and so on. They are understood by their fellows, and they are expressive of emotions and not of ideas. The loud cackling of a rooster which I hear as I write expresses in a vague way some excitement, pleasurable or otherwise. Or he may be signaling to the cackling hen to guide her to the flock, an instinct inherited from his jungle-fowl ancestors.

The parrot, of course, does not know the meaning of the words it repeats so glibly; it only associates certain sounds with certain acts or occasions, and says "Good-by," or "Come in," at the right time because it has been taught to connect these sounds with certain sense impressions through the eye and ear. When a child is in pain, it cries; when it is pleased, it laughs: always are its various sounds expressive of some immediate concrete want or experience. This is the character of all animal language; it does not express ideas, but feelings — emotions then and there experienced —

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the result of an inward impulse or an outward condition.

With ourselves, emotion arises spontaneously and is not the result of will. We cannot be angry, or joyous, or depressed, or experience the emotion of the beautiful, or of the sublime, or of love, or terror, by mere willing. These emotions arise under certain conditions that are not matters of will or calculation. If a man does not flee from danger, real or imaginary, like an animal, it is because his reason or his pride has stepped in and stopped him. Man's reason shows itself in checking or controlling his emotion, while the lower animals have no such check or stay. A man may think about the danger from which he flees, or about the scene that thrilled him, or of the woman that moved him, but the thinking always follows the emotion, while the horse or the dog flees without stopping to think.

Without doubt, to me at least, man has climbed up from some lower animal form, but he has, as it were, pulled the ladder up after him. None of man's humbler kindred, even if man were to reach them a hand, or a dozen hands, could now mount to the human plane.

As there must be a point back along the line of our descent where consciousness began — consciousness in the animal and self-consciousness in man — so there must be a point where reason began. If we had all the missing links in the chain,

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no doubt we might, approximately at least, determine the form in which it first dawned. The higher anthropoid apes, which are, probably, a lateral branch of the stem of the great biological tree that bore man, show occasional gleams of it, but reason, as we ascribe it to the lower orders, is more a kind of symptomatic reason, a vague foreshadowing of reason rather than the substance itself. For a long time the child is without reason, or any mental concepts, and all its activities are reactions to stimuli, like those of an animal; it is merely a bundle of instincts, but by and by it begins to show something higher and we hail the dawn of reason, and the child's development from the animal plane into the human.

The development of reason in the race of man has of course been as gradual as the development of his body from some lower animal form, but is it any more startling or miraculous than those slow transmutations or transformations which we trace everywhere in nature, and which in the end amount to complete metamorphosis? It is a new thing in the animal world, and separates man from the lower orders by an impassable gulf. The gulf has been crossed in the past; not by a sudden leap, but by slow growth and transmutation, just as the gulf between the bird and reptile, or between the reptile and the amphibian, has been crossed. Man is separated from the lower orders less by a phys-

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ical than by a psychological gulf. His anatomy is fundamentally the same, though there is doubtless an invisible gulf in the molecules of the brain cells; but his psychology is fundamentally different. Is this difference any greater, it may be asked, than that which separates the highest human intelligence from that of the lowest savage? I look upon it more as a difference of kind than of degree. It is comparatively easy to trace a continuous line of development from the mind of the Hottentot to the mind of the foremost European, but between the savage and our pithecoïd ancestors there are many missing links. The evolutionary process that must have connected them has worked out something like a metamorphosis.

Darwin in seeking to prove the animal origin of man felt called upon to show at least the rudiments of man's reasoning powers in his humbler beginnings. Certain it is that evolution must have something to go upon. But does it not have enough to go upon in the kind of intelligence the unthinking animal world exhibits? The slow metamorphosis of this into human reason is no more difficult to conceive of than a hundred other slow metamorphoses that may be traced in nature, wherein we see the adult animal totally unlike its youthful beginning, or where we see two chemical elements uniting to form a third entirely unlike either. Animal and vegetable life doubtless had a common

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origin, but behold how they have diverged. How could the intelligence of one have been evolved out of the intelligence of the other without this mystery of slow metamorphosis?

I do not know how far back along the line of evolution in animal life biologists place the beginning of the sense of sight, certainly the highest of all bodily senses. But it must have begun somewhere a good way this side of the first unicellular life; the eye as an organ and as we know it is doubtless a late development. And what a marvel it is! What can be a greater departure from the sense of touch and taste and smell — more like a miraculous addition or metamorphosis — than the sense of sight? And yet its foundation is the same as that of the other senses, nerve sensibility.

Or take another near-at-hand illustration. What can seem more like a new birth, a new creation, than the flower of a plant when contrasted with its leaves and stalk and root? Yet all this delicacy and color and fragrance come by way of these humbler parts; indeed, lay dormant there in the soil till this something we call life drew them out of it and built them up into this exquisite form. In the same way, may not the animal nature in the course of long ages have blossomed into the mental and spiritual powers which man possesses, and which are only latent in the lower creatures? We see the miracle of the flower daily, but the other miracle is

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a slow process that no man has witnessed or can witness. Strike out the element of time, and we see it as we see the stalk bring forth the flower, or as we see the grub metamorphosed into the butterfly.

We turn smoke into flame by supplying the fire with a little more oxygen. Has any new thing been added? What is added to transmute animal intelligence into human seems to be only more oxygen — more of that which favors mental combustion — more brain matter and a finer nervous organization.

III

We translate the action of bird and beast into human thought just as we translate their cries and calls into human speech. But the bird does not utter the words we ascribe to it, it only makes a sound that suggests the words. So its behavior is not the result of thought, but it is such as to suggest thought to a thinking animal, and we proceed to explain it in terms of thought.

We see a crow approaching a bit of meat upon the lawn in winter and note his suspicion. He circles about and surveys it from all points and approaches it with extreme caution, and we say he suspects some trap or concealed enemy, or plot to do him injury, when in fact he does not consciously suspect anything or think anything; he is simply obeying his inborn instinct to be on the lookout for danger at all times and in all places — the instinct

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of self-preservation. When the chickadee comes to the bone or bit of suet upon the tree under your window, it does so with little or no signs of suspicion. Its enemies are of a different kind, and its instincts work differently. Or when we see a fox trying to elude or delay the hound that is pursuing him, by taking to rail fences or bare plowed fields, or to the ice of frozen streams, we say he knows what he is doing; he knows his scent will not lie upon the rail or the bare earth or the ice as upon the snow or the moist ground. We translate his act into our mental concepts. The fox is, of course, trying to elude or to shake off his pursuer, but he is not drawing upon his stores of natural knowledge or his powers of thought to do so; he does not realize as you or I would that it is the scent of his foot that gives the clue to his enemy. How can he have any general ideas about odors and surfaces that best retain them? He is simply obeying the instinctive cunning of his vulpine nature, and takes to the fence or to the ice or to the water as a new expedient when others have failed. Such a course on our part under like circumstances would be the result of some sort of mental process, but with the fox it is evidence of the flexibility and resourcefulness of instinct. The animals all do rational things without reason, cunning things without calculation, and provident things without forethought. Of course we have to fall back upon

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instinct to account for their acts — that natural “propensity,” as Paley defined it, which is “prior to experience and independent of instruction.”

In both the animal and vegetable worlds we see a kind of intelligence that we are always tempted to describe in terms of our own intelligence; it seems to run parallel to and to foreshadow our own as to ways and means and getting on in the world — propagation, preservation, dissemination, adaptation — the plant resorting to many ingenious devices to scatter its seed and to secure cross-fertilization; the animal eluding its enemies, hiding its door or its nest, finding its way, securing its food, and many other things — all exhibiting a kind of intelligence that is independent of instruction or experience, and that suggests human reason without being one with it. Each knows what its kind knows, and each does what its kind does, but only in man do we reach self-knowledge and the freedom of conscious intelligence.

The animals all profit more or less by experience, and this would at first thought seem to imply some sort of mental capacity. But vegetables profit by experience also, and mainly in the same way, by increasing power to live and multiply. Hunt an animal and it becomes wary and hardy; persecute a plant and it, too, seems to tighten its hold upon life. How hardy and prolific are the weeds against which every man's hand is turned! How full of

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resources they are; how they manage to shift for themselves, while the cultivated plants are tender and helpless in comparison! Pull up redroot in your garden and lay it on the ground, and the chances are that one or more rootlets that come in contact with the soil will take hold again and enable the plant to mature part of its seeds. This adaptability and tenacity of life is, no doubt, the result of the warfare waged against this weed by long generations of gardeners. Natural selection steps in and preserves the most hardy. Of course the individual animal profits more by experience than the individual plant, yet the individual plant profits also. Do not repeated transplantings make a plant more hardy and increase its chances of surviving? If it does not learn something, it acquires new powers, it profits by adversity.

IV

But as the animal is nearer to us than the vegetable, so is animal intelligence nearer akin to our own than plant intelligence. We hear of plant physiology, but not yet of plant psychology. When a plant growing in a darkened room leans toward the light, the leaning, we are taught, is a purely mechanical process, the effect of the light upon the cells of the plant brings it about in a purely mechanical way; but when an animal is drawn to the light, the process is a much more complex one,

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and implies a nervous system. It is thought by some that the roots of a water-loving plant divine the water from afar and run toward it. The truth is, the plant or tree sends its roots in all directions, but those on the side of the water find the ground moister in that direction and their growth is accelerated, while the others are checked by the dryness of the soil. An ash tree stood on a rocky slope where the soil is thin and poor, twenty or twenty-five feet from my garden. After a while it sent so many roots down into the garden, and so robbed the garden vegetables of the fertilizers, that we cut the roots off and dug a trench to keep the tree from sending more. Now the gardener thought the tree divined the rich pasturage down below there and reached for it accordingly. The truth is, I suppose, that the roots on that side found a little more and better soil, and so pushed on till they reached the garden, where they were at once so well fed that they multiplied and extended themselves rapidly. Both plant and tree know a good thing when they find it. How could they continue if they did not?

A birch tree starting life upon the top of a rock, — as birch trees more than any others are wont to do, — where the soil is thin, soon starts a root down to the ground several feet below in what seems a very intelligent way. Now the tree cannot know that the ground is there within reach. On one side of the rock, usually on the north side, it finds

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moss and moisture, and here the root makes its way. When it reaches the edge of the rocks, it bends down just as a fluid would do and continues its course till it reaches the ground; then it rejoices, so to speak. All other roots are called in or dry up, this one root increases till it is like a continuation of the trunk itself, and a new root system is established in the ground. But why we find the birch more often established upon a rock than any other tree, I do not yet know.

I know of a little birch tree that is planted in the niche on the face of an almost perpendicular rock in the edge of the woods. There has been a tree, probably a birch, in the same niche before it, and in this mould of its ancestor the tree is planted. It has wedged its roots into the rock wherever there is a seam or crack, and it must have thriven fairly well on its scant rations of soil for several years, or until it became a sapling the size of one's wrist. Then it started a root diagonally down the face of the rock toward the ground, about four feet distant. How that root made its way there on that bare, smooth surface, where there is only a thin wash of lichens, is a mystery. But it did, and it reached the ground and is now the size of a broom handle, and is doubtless the tree's main source of sustenance.

What prompted the tree to send it down, to organize and equip this relief expedition to the soil

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across the desert face of the rock? I have always supposed a growing root lived off the country it traveled over, but in this case it must have been fed from the rear; the tree pushed it on even when it brought in no supplies. How interesting it would be to know how far this root would have traveled across that bare rock-face had the ground been many yards away! Have trees more wit than is dreamed of in our philosophy?

The intelligence of the plants and flowers of which Maeterlinck writes so delightfully is, of course, only a manifestation of the general intelligence that pervades all nature. Maeterlinck is usually sound upon his facts, however free and poetic he may be in the interpretation of them. The plants and flowers certainly do some wonderful things; they secure definite ends by definite means and devices, as much so as does man himself — witness the elaborate and ingenious mechanical contrivances by which the orchids secure cross-fertilization. Yet if we are to use terms strictly, we can hardly call it intelligence in the human sense, that is, the result of reflection on the part of the plant itself, any more than we can ascribe the general structure and economy of the plant, or of our own bodies, to an individual act of intelligence.

There are ten thousand curious and wonderful things in both the animal and vegetable worlds, and in the organic world as well, but it is only in a poetic

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and imaginative sense that we can speak of them as the result of intelligence on the part of the things themselves: we personify the things when we do so. The universe is pervaded with mind, or with something for which we have no other name. But it is not as an ingenious machine, say the modern printing-press, is pervaded with mind. The machine is a senseless tool in the hands of an external intelligence; in nature we see that the intelligence is within and is inseparable from it. The machine is the result of mind, but things in nature seem the organs of mind.

IX

THE REASONABLE BUT UNREASONING ANIMALS

I

THERE is to me a perennial interest in this question of animal instinct *versus* intelligence, and I trust my readers will pardon me if I again take the question up. Ever since one of our leading weekly journals (last June) declared its belief that "animals are capable of reasoning from certain premises, and do possess and express, though in a rudimentary form, many of the moral and intellectual processes and sentiments of man," I have wanted to take another shot at the subject. I do not now recall that any one has before claimed that the lower animals possess many of the moral sentiments of man, though a goodly number of persons seem to have persuaded themselves that animals do reason. Even so competent a naturalist as Mr. Hornaday says that asking if animals reason is to him like asking if fishes swim. But I suspect that Mr. Hornaday is a better naturalist than he is a comparative psychologist, because all the eminent comparative psychologists, so far as I know them,

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have reached the conclusion that animals do not reason. That eminent German psychologist, Wundt, says that the entire intellectual life of animals can be accounted for on the simple law of association; and Lloyd Morgan, the greatest of living English comparative psychologists, in his discussion of the question, "Do animals reason?" concludes that they do not — they do "not perceive the *why* and think the *therefore*." He urges, very justly, I think, that "in no case is an animal's activity to be interpreted as the outcome of a higher psychic faculty if it can fairly be interpreted as the outcome of faculties which are lower in the psychological scale." That is to say, Why impute reason to an animal if its behavior can be explained on the theory of instinct?

Some of our later nature writers seek to cut out instinct entirely, and call it all reason. If we cut out instinct, then we have two kinds of reason to account for and our last state is worse than our first. The young dog that in the house takes a bone and goes through the motions of burying it on the kitchen floor, digging the hole, putting it in, covering it up, and pressing the imaginary soil down with his nose, does not show the same kind of intelligence that even a child of four does when she puts her dolly in its little bed and carefully tucks it up. The one act is rational, the other is irrational; one is the result of observation, the other is inherited memory.

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There is much in a hasty view of animal life that looks like reason, because instinct is a kind of intelligence and it acts in a reasonable manner. But when we get something like an inside view of the mind of the lower orders, we see how fundamentally it differs from the human. And we get this view of it, not in the ordinary course of the animal's life, because the ordinary course of its life is appointed by its inherited instincts, but under exceptional conditions, when it encounters a new problem. Now, when a reasoning intelligence is confronted by a new problem, it recognizes it as such, and, having a fund of knowledge and experience to draw upon, it proceeds to deal with it accordingly. Not so the animal; it does not know the new problem when it sees it, and in its dealings with it acts much like a machine that was made to do some other work.

Let me group together here a number of instances from animal life, some of which I have given elsewhere in my writings, which show how much nearer the lower orders come to being mere automata than they come to being reasoning intelligences.

Take the case of the robin or bluebird that may often be seen in the spring, day after day, dashing itself madly against a window-pane, fighting its fancied rival there in its own reflected image, and never discovering that it is being fooled even after it has taken a peep into the empty room inside

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through a broken pane; or the case of the red squirrel that carried nuts all one day and put them into the end of a drain pipe that ran down an embankment wall and opened on to a pavement below, where the nuts behaved much as the water did that the pipe was meant to carry — they dropped down and rolled away across the street pavement. Or the case of the beaver that cut down a tree four times because the tree was held by the branches of other trees at the top so that it could not fall, but only dropped at each cutting the distance of the piece cut off. What finally decided the beaver to desist, it would be interesting to know. Or take the case of Hamerton's cow that in affection for her calf licked its stuffed skin till it ripped open and the hay with which it was stuffed fell out, when the bereaved mother proceeded to eat the hay with the utmost matter-of-course air.

During some long-gone time in the history of the raccoon it seems to have been needful for it to wash its food. Maybe the habit was acquired when it lived more exclusively than it does now upon freshwater mussels, which it dug out of the mud along inland streams and lakes. At any rate, the coon now always washes its food, whether it needs washing or not, and in muddy water as promptly as in clear, so that the Germans call the coon the *Waschbär*. Ernest Harold Baynes tells me that he has taken young coons before their eyes were open, and

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brought them up on milk, and that the first time he gave them solid food, one of them took it and ran to a pail of water which it had never before seen, thrust the food into it, washed it, and then ate it. When no water was within reach, he has seen the coon rub the food a moment in its paws and then drop it. Dallas Lore Sharp says that his tame coon would go through the motions of washing its food on the upturned bottom of its empty tub, and that it would try to wash its oysters in the straw on the floor of its cage. This habit, I say, doubtless had its origin in some past need or condition of the life of the race of coons, and it persists after that need is gone.

The story that is told of the brakeman upon a train of cars in Russia, who at each stop of the train went from wheel to wheel, as was once the custom in all countries, and hit it a sharp blow with a hammer, saying on being asked why he did it, "I do not know, sir, it is my orders," illustrates very well the unreasoning character of animal instinct. The animal has its orders, but it does not think or ask why.

At Bahia Blanca, in South America, Darwin saw a bird, the casarita, that builds its nest in holes which it drills in the banks of streams like our kingfisher. At one place where he was stopping, the walls around the house were built of hardened mud, and were bored through and through with holes by these

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birds in their attempts to form their nests. The mud wall attracted them as if it had been a natural earth bank, and in trying to reach the proper depth for their nests, six feet or more, they invariably came through and out on the other side. Still they kept on drilling. Says Darwin:—

“I do not doubt that each bird, as often as it came to daylight on the opposite side, was greatly surprised at the marvelous fact.”

I do not suppose the bird really experienced any feeling of surprise at all, any more than the blue-bird above referred to did, when it looked into the vacant room and did not see the object of its wrath. The feeling of surprise comes to beings that understand the relation of cause and effect, which evidently the lower animals do not. Had the casarita been capable of the feeling of surprise, it would have been capable of seeing its own mistake.

Our high-hole is at times guilty of the same folly. When he drums on the metal ventilator or the tin leader upon your house, he has found a new thing, but it suits his purpose to make a noise to attract the attention of the female rather better than the dry stub did. And when he excavates a limb or tree-trunk for his nest, he acts like a reasonable being; but when he drills a hole through the clapboards of an empty building, and, not finding that the interior is what he wants, drills again and again, or perforates over and over the covering of an ice-house and

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lets out the sawdust, as I have often known him to do, what does he act like then?

Such instances reveal as by a flash of light the nature of animal mentality — how blindly, how automatically, the beasts act. If a person ever behaved in that way, we should say he had lost his mind, that reason was dethroned. We should not merely say he was unreasonable, we should say he was insane.

In its ordinary course of life the animal behaves in a reasonable manner, its course of action follows regular lines. Its progenitors have followed the same lines for countless generations; habit has worn a groove. But when a new, unheard-of condition confronts them, then there is no groove and their activity takes these irrational forms. When the phoebe-bird covers her nest in the ledge with moss, she does a reasonable thing; she blends it with the rock in a way that is both good art and good strategy. Now, if this were the result of reason, when she comes to the porch and to newly hewn timbers she would leave the moss off, because here it betrays rather than conceals her nest. But she sticks to her moss wherever she goes.

The same curious blundering may be seen in the insect world. For instance, the trap-door spiders in California make their nests in moss-covered ground and cover the lids of the doors with green growing moss. An English naturalist, as reported by Jordan

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and Kellogg in their "Animal Life," removed the moss and the other assimilative material from the door and found that the spider always replaced it. Then he removed it again, and with it the moss and débris from the ground in a large circle about the nest. This, of course, left the door as well concealed as before because it made it one with its surroundings. Did the spider leave it so? Not a bit of it. She fetched more moss and bits of bark and sticks and covered it as before, which gave away her secret completely. If she had done otherwise, or had covered her door with soil so as to make it one with its environment, we should have had to credit her with a faculty higher than instinct.

While speaking of insects in connection with this subject of the automatic character of animal intelligence, I am reminded of the habit of one of the solitary wasps as described by Fabre. When the wasp brings an insect to its hole, it lays it down at the entrance and backs down into the hole, apparently to make some examination, then comes out and drags in its prey. Fabre watched his opportunity, and, when the wasp had disappeared in her den, removed her game a few inches away. The wasp came out, hunted for her bug, found it and drew it back to its former position, then dropped it and retreated into her den as before. Fabre again drew the insect away, and again the wasp came out and repeated her former behavior. Time after

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time this little scene was enacted; the wasp *must* go into her den and make her preliminary survey before dragging in her prey. That habit had become fixed and there could be no deviation from it, and yet the wasps in many ways seem so surprisingly intelligent!

Another bee upon which Fabre experimented builds a cell of masonry, fills it with honey, lays her egg in it, and then seals it up. When the bee was away, Fabre punctured the half-filled cell and let the honey flow out. When the bee returned, she appeared to be disturbed to find her honey gone; she examined the hole through which it had escaped curiously, but made no attempt to repair it, and continued to pour in the honey the same as before. After she had brought the usual quantity — the quantity her forbears had always brought — she laid her egg in, the empty cell and sealed it up. The machine had done its work, and it could do nothing not down in the ancestral specifications.

Dan Beard tells of an ichneumon-fly that tried all one day to thrust its ovipositor into a nail-head in a board in his cabin, mistaking the dark spot which the nail-head made for a hole that led to the burrow of a certain wood-borer which is the host of the ichneumon. Beard thinks the fly desisted only when it had seriously dulled the point of its instrument. I am reminded of one of our well-known wild flowers, the erythronium or fawn lily, that will persist in a

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certain habit, no matter how many times defeated. This plant forms a new bulb each spring by sending out a big tap-root, that bores down into the ground and plants the new bulb deeper and deeper each season till the required depth of six or eight inches is reached. When the ground is so hard that the pioneer root cannot penetrate it, it wanders in loops over the surface and forms the new bulb no deeper than the old one was, and keeps this habit up spring after spring, groping its way blindly about over the hard surface.

As further illustration of the automatic character of animal instinct, take the case of the migrating lemmings in Norway and Sweden. At times the country gets overstocked with these rodents, when vast numbers of them migrate down from the hills toward the sea, swimming the lakes and rivers in their way. This seems a reasonable course, and is very much what men would do under like circumstances; their instincts accord with reason. But mark what follows: when the lemmings reach the sea, they plunge in and swim till they perish. Having got in motion, they go on, like any other natural force, till they have spent themselves. It is said that steamships have at times encountered these bands of swimming rodents and been half an hour in steaming through them. I do not suppose they mistake the sea for another lake or river such as they have already crossed; I do not suppose any notions

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or comparisons exist in their minds about it. An impulse to migrate, which is like a decree of nature, has taken possession of them, and they obey it blindly, to their own destruction. These incidents, which recur at intervals, afford another illustration of how radically animal instinct differs from human reason. It is a kind of fate.

Instinct may be thwarted in its efforts, but it cannot be convinced that its effort is wrong, or has failed. One spring, as I have elsewhere related, a pair of English sparrows, in searching for a nesting-place, tried to effect an entrance into the interior of a horizontal timber upon my porch, through a large crack. Not being able to do this, they brought straws and weed stalks and filled up the crack from one end of the porch to the other, working at it day after day notwithstanding their rubbish was repeatedly swept away. It was nesting-time, the opening in the timber stimulated them, and they kept going as did the birds I have mentioned above. I do not suppose they had any knowledge that their efforts were futile; they only had the impulse to build, and of that impulse they did not know the purpose.

I have not cited the foregoing incidents to show the stupidity of bird or beast or insect — that were as great an error as to seek to prove their reasoning powers — but simply to illustrate the automatic character of animal behavior; to show that, if the lower orders are not mere automata, as Des Cartes

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long ago taught and as Huxley came to believe, adding only the qualifying adjective "conscious," making them "conscious automata," — then they come so near to it that it is difficult without exaggeration to credit them with any higher powers. At any rate, they reveal an order of mind that differs fundamentally from our own. Unless we are to abandon that comparison and classification which is the basis of all our knowledge, we must call it by another name — we must call it blind instinct. It does not see the why of anything which it does.

II

My dog and I are boon companions. I can live with him almost as with a brother, and yet I see him across a gulf. I catch a glimpse of that gulf, for example, when I see by his manner that he wants to lie down before the open fire, but, the poker or a stick of wood being in the way, instead of removing or pushing it to one side, as he could so easily do, he sits or half reclines there, and looks helplessly at the obstacle in his way. I get up and remove it and he lies down. The removal of that poker on his part would require a certain detachment and viewing of himself in relation to other things, of which he is not capable; and yet I know, had the obstacle barred the way to the retreat of a mouse or a chipmunk, he would have removed it in a hurry, because the scent of the

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game would have stimulated his instincts, or set up a reflex action, and put his paws in vigorous motion. He will, in an awkward kind of way, try to remove the burrs and bidens seeds from his coat, and bite at a sliver in his foot — these things irritate him and hence sustain a much closer relation to him than did the poker or the stick of wood; his instinct of self-defense is more or less aroused by them.

One's dog will come to cover when it rains, but can one think of him as putting on any cover to keep off the rain, or as bringing in his blanket out of the wet, unless especially trained? All such minor human acts are quite beyond the capacity of our wild or domestic animals, requiring as they do a certain self-detachment and viewing of things as they are in their relations.

Touch the spring of an animal's instinct or inherited habit, and it responds; but appeal to its power of independent thought, and it is, for the most part, as helpless as any other machine.

Birds will remove obstacles from their nests, and a setting hen will steal eggs from a nest within reach of her own. Such behavior shows only how acute and active their instincts are during the crisis of propagation.

The lower animals all seem to be upon the same plane; they are all yet at the breast of Nature, as it were, directly and unconsciously dependent upon her, while man has long since been weaned and

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separated from her. He has moved into another plane of being, still dependent, of course, upon the Nature of which he is, in a measure, the master. He still runs down into the region of reflex action, but he also runs up into the region of choice and reason and invention, where the animal does not follow him.

Man is emancipated, the animal is in bondage. And yet man surely came by the way of the lower animals. In these forms he tarried, these are his kith and kin; their marks are still upon him. But how he ever left them so far behind, who can tell? How did he cut loose from them? Why is my dog on one side of the gulf and I on the other? Why was he left behind by the impulse that brought me over? Why are we not either all dogs or all men? The wave has traveled, but the water has stayed behind. What started the wave? Where is the source of the force it represents? This man-impulse that has never been stayed, what or who started it? Through good and through evil report has it come, through slime and ooze, and reptile and fish, through monsters and dragons, and cat-aclysm, and cosmic winters and summers, and has arrived safely at last with man on its crest.

Of course the animals show many human traits; their whole emotional life — and it is doubtful if they have any other — seems to run parallel to our own. They live in feeling, not in thought. Huxley says that this is because they have no language.

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They have no language because their brains are not developed to the language point. But to have emotions and feelings and associations and repulsions, the sense of direction, the sense of home, the love of offspring, the fear of enemies, we do not need a language, we need only the senses.

The animals show human traits every hour in the day, but my contention is that they do not show anything like human intelligence. The two pairs of orioles I saw one day come in collision as I was passing along the road behaved, I thought, in a very human way. Each couple had a nest in elm trees that stood near one another on the roadside, and were, of course, more or less jealous of each other's rights. As I was passing, the two females had come to blows in a clump of willows a few yards away and were having a lively scrap. Instantly the two males appeared, hurrying side by side to the scene of the squabble of their mates. Just what took place on their arrival I could not clearly make out, except that the females separated and the males came to blows. After sparring a moment or two, they alighted on the wire fence a few feet apart, where they eyed each other sharply and exchanged some very emphatic words, the purport of which I could only guess. How very human, I thought, that two husbands, in interfering in a quarrel between their wives, should get each other by the ears! My neighbor and I got

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into a "scrap" in trying to separate our dogs, exercising no more reason in the matter than did the orioles.

When Hobhouse, the English psychologist and philosopher, was trying to teach his elephant how to draw a bolt to open a box that contained a sweet morsel, the elephant used to lose its temper at times and bang the box around like a petulant child — a very human proceeding, I thought.

My son had a duck that one fall behaved, as it seemed to me, in quite a human way. He had a wild strain in him, and was brought up near the sea. He had lost his mate during the summer, and when fall came, I suppose the migrating instinct began to stir in him. He seemed uneasy and would leave the hens and wander off alone, softly calling as he walked. One night in early October he was missing, and we fancied a fox had snapped him up in the twilight. Days passed, till one evening one of the men saw a solitary duck flying past low over the buildings and fruit trees upon the lawn. He said it looked like our lost duck. A few days later the report came from our neighbor of a very tame wild duck upon the river. The duck had come ashore near his house, and he, not having a gun, had tried to capture it by a slip-noose at the end of a pole. But the duck took fright and flew away down the river. A day or two later it appeared again near our neighbor's house, and now,

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having learned that it was probably our lost duck, our neighbor set out to capture it by the use of corn, and finally succeeded. He then clipped one wing and turned it loose. The drake, failing in his efforts to fly, was a changed bird; disaster made him think of home, and the next day at twilight he turned his steps thitherward. He came slowly laboring up the hill, very silent and humble, and allowed himself to be picked up. It was hardly the return of a prodigal, but it was the coming back of a humbled and disappointed wanderer.

III

Animal conduct parallels human conduct in many particulars, but to say that it is the result of the same mental processes is, I believe, to make a capital mistake. Why, inorganic nature often seems to copy human methods, too, as, for instance, in a natural bridge. Behold on what sound mechanical principles the rude arch or span is built up! Shall we therefore ascribe the faculty of reason to the rocks? Or behold how the mountain-walls are buttressed, the overhanging cliff supported — it is all good engineering. In nature such things are the inevitable result of irrefragable mechanical laws; with the lower animals they are the result of instinct; with man they are the result of reason.

I notice that when the phoebe-bird builds her nest on the steep surface of a ledge, she begins like

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a true mechanic and widens her foundation gradually as she comes upward, till she has a shelf of mud wide enough to stand it on. It is all fit and well considered. We may think that the bird reasoned, and fail to see how inevitable all such things are in organic as well as in inorganic nature. The trees buttress themselves at their base by a circle of high curving roots, and how their branches are braced and reinforced where they leave the trunk!

The beaver building its dam seems like a reasonable being, and L. H. Morgan, who studied this animal in its native haunts in Wisconsin, and wrote the best monograph upon the subject that has ever appeared, thinks that it does reason; but one incident alone which he mentions shows by what unreasoning instinct the animal is guided. He saw where the beavers had built a dam by the trunk of a tree that had fallen across a stream, but instead of placing their sticks and brush against the upper side of the tree, so as to avail themselves of it in resisting the force of the current, they had placed them below it, so that the tree helped them not at all. Poor things! they encountered a new problem. They could build a dam, but they could not take advantage of the aid which the wind had offered them. Probably, had they felled the tree themselves, their instinct would not have blundered so in dealing with it.

As animals get along very well without hands

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and tools, so they get along very well without reason. Nature has given them tools in their organization in a sense that she has not given them to man — special appliances developed to meet special needs, such as hooks, spears, saws, files, chisels, barbs, drills, shears, probes, stings, drums, fiddles, cymbals, harps, glues, pastes, armors, stilts, pouches, all related to some need of the creature's life; and in the same way she has given them the quality of reason in their instincts. She has given the beaver knives and chisels in his teeth, she has given the woodpeckers drills in their beaks, she has given the leaf-cutters shears in their mandibles, she has given the bees baskets on their hips, she has given stilts to the waders and bills that are spears, to birds of prey claws that are hooks, and to various creatures weapons of offense and defense that man cannot boast of. Man has no tools or ornamental appendages in his organization, but he has that which can make and use these things — arms and hands, and reason to back them up. I can crack my nut with a stone or hammer, but the squirrel has teeth that help him to the kernel. Each of us is armed as best suits his needs. The mink and the otter can take their fish in the water, but I have to have a net, or a hook, or a weapon of some kind when I catch fish. The woodpecker can chisel out a hole in a tree for his nest or his house, with only the weapon nature gave him, but he cannot make a door to it, or patch it if it be

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comes leaky. The trap-door spider can build a door to her den, because this instinct is one of her special equipments, and is necessary to her well-being. To the woodpecker such a door is not a necessity.

There are but few things we could teach the animals in their own proper sphere. We could give them hints when they are confronted by new problems, as in the case of the beaver above referred to, but in the ordinary course of nature these new problems rarely turn up. We could teach the beaver a little more system in the use of his material, but this would be of slight value to him; his dam, made very much as a flood makes a dam of driftwood and mud, answers his purpose. Could we teach the birds where to find a milder clime, or the dog how to find his way home, or the horse how to find water in the desert, or the muskrat or the beaver how to plan and construct houses better suited to their purposes? Could we teach the birds how better to hide their nests? Do the conies amid the rocks, that cure their hay before storing it up for winter use, need to take counsel of us? or the timid hare that sleeps with its eyes open, or the sluggish turtle that covers her eggs in the warm sand? Can we instruct the honey-bee in her own arts, or the ant in hers? The spider does not need to learn of us how to weave a net, nor the leaf-rolling insect to be taught the use of stitches. I do not know that we first learned the art of paper-making

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from the hornets, but certain it is that they hold the original patent for making paper from wood-pulp; and the little spiders navigated the air before the first balloon was made, and the *Physalia* hoisted her sail long before the first seaman spread his, and the ant-lion dug his pit and the carpenter-bee bored his hole long before man had learned these arts. Indeed, many of the arts and crafts of man exist or are foreshadowed in the world of life below him. There is no tool-user among the lower animals that I know of, unless we regard one of the solitary wasps as such when she uses a pebble with which to pack down the earth over her den; but there are many curious devices and makeshifts of one kind and another among both plants and animals for defense, for hiding, for scattering of seeds, for cross-fertilization, etc. The wild creatures have all been to school to an old and wise teacher, Dame Nature, who has been keeping school now, as near as we can calculate, for several million years. And she is not an indulgent teacher, though a very patient one. Her rod is tooth and claw and hunger and cold and drought and flood, and her penalty is usually death. Her ways are not all ways of pleasantness, nor are all her paths paths of peace.

When the animals are confronted by conditions made by man, then man can give them valuable hints. We could teach the cliff swallows better than to stick their mud nests on boards that have

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been planed and painted, because sooner or later they are sure to fall. We could teach the cunning crow not to be afraid of a string stretched across the cornfield, and the wary fox not to be barred from a setting fowl by a hoop of iron, and we could teach him to elude the hounds by taking to the highway and jumping into the hind end of a passing farm wagon on the way to the mill and curling up among the meal-bags, as Mr. Roberts's fox did. We could instruct the bird with broken legs how to make clay casts for them, and to give the clay a chance to harden, as the woodcock of Dr. Long did. The wild animals do not need our medicine because they are probably never ill, and only upon very rare occasions could our surgery be of use to them. The domestic animals sometimes need a midwife, but probably the wild creatures never do. They all learn slowly the things that it is necessary for them to know. In time, I have no doubt, the migrating birds will learn to avoid the lighthouses along the coast, where so many of them now meet their death.

Animals know what they have to know in order that the species may continue, and they know little else. They do not have to reason because they do not progress as man does. They have only to live and multiply, and for this their instincts suffice them. Neither do they require any of our moral sentiments. These would be a hindrance rather than a help, and, so far as I can see, they do not have them.

X

THE GRIST OF THE GODS

ABOUT all we have in mind when we think of the earth is this thin pellicle of soil with which the granite framework of the globe is clothed — a red and brown film of pulverized and oxidized rock, scarcely thicker, relatively, than the paint or enamel which some women put on their cheeks, and which the rains often wash away as a tear washes off the paint and powder. But it is the main thing to us. Out of it we came and unto it we return. “Earth to earth, and dust to dust.” The dust becomes warm and animated for a little while, takes on form and color, stalks about recuperating itself from its parent dust underfoot, and then fades and is resolved into the original earth elements. We are built up out of the ground quite as literally as the trees are, but not quite so immediately. The vegetable is between us and the soil, but our dependence is none the less real. “As common as dust” is one of our sayings, but the common, the universal, is always our mainstay in this world. When we see the dust turned into fruit and flowers and grain by that intangible thing called vegetable life, or into the bodies of men and women by the equally mys-

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terious agency of animal life, we think better of it. The trembling gold of the pond-lily's heart, and its petals like carved snow, are no more a transformation of a little black muck and ooze by the chemistry of the sunbeam than our bodies and minds, too, are a transformation of the soil underfoot.

We are rooted to the air through our lungs and to the soil through our stomachs. We are walking trees and floating plants. The soil which in one form we spurn with our feet, and in another take into our mouths and into our blood — what a composite product it is! It is the grist out of which our bread of life is made, the grist which the mills of the gods, the slow patient gods of Erosion, have been so long grinding — grinding probably more millions of years than we have any idea of. The original stuff, the pulverized granite, was probably not very nourishing, but the fruitful hand of time has made it so. It is the kind of grist that improves with the keeping, and the more the meal-worms have worked in it, the better the bread. Indeed, until it has been eaten and digested by our faithful servitors the vegetables, it does not make the loaf that is our staff of life. The more death has gone into it, the more life comes out of it; the more it is a cemetery, the more it becomes a nursery; the more the rocks perish, the more the fields flourish.

This story of the soil appeals to the imagination.

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To have a bit of earth to plant, to hoe, to delve in, is a rare privilege. If one stops to consider, one cannot turn it with his spade without emotion. We look back with the mind's eye through the vista of geologic time and we see islands and continents of barren, jagged rocks, not a grain of soil anywhere. We look again and behold a world of rounded hills and fertile valleys and plains, depth of soil where before were frowning rocks. The hand of time with its potent fingers of heat, frost, cloud, and air has passed slowly over the scene, and the miracle is done. The rocks turn to herbage, the fetid gases to the breath of flowers. The mountain melts down into a harvest field; volcanic scoria changes into garden mould; where towered a cliff now basks a green slope; where the strata yawned now bubbles a fountain; where the earth trembled, verdure now undulates. Your lawn and your meadow are built up of the ruins of the foreworld. The leanness of granite and gneiss has become the fat of the land. What transformation and promotion! — the decrepitude of the hills becoming the strength of the plains, the decay of the heights resulting in the renewal of the valleys!

Many of our hills are but the stumps of mountains which the hand of time has cut down. Hence we may say that if God made the mountains, time made the hills.

What adds to the wonder of the earth's grist is

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that the millstones that did the work and are still doing it are the gentle forces that career above our heads — the sunbeam, the cloud, the air, the frost. The rain's gentle fall, the air's velvet touch, the sun's noiseless rays, the frost's exquisite crystals, these combined are the agents that crush the rocks and pulverize the mountains, and transform continents of sterile granite into a world of fertile soils. It is as if baby fingers did the work of giant powder and dynamite. Give the clouds and the sunbeams time enough, and the Alps and the Andes disappear before them, or are transformed into plains where corn may grow and cattle graze. The snow falls as softly as down and lies almost as lightly, yet the crags crumble beneath it; compacted by gravity, out of it grew the tremendous ice sheet that ground off the mountain summits, that scooped out lakes and valleys, and modeled our northern landscapes as the sculptor his clay image.

Not only are the mills of the gods grinding here, but the great cosmic mill in the sidereal heavens is grinding also, and some of its dust reaches our planet. Cosmic dust is apparently falling on the earth at all times. It is found in the heart of hailstones and in Alpine snows, and helps make up the mud of the ocean floors.

During the unthinkable time of the revolution of the earth around the sun, the amount of cosmic

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matter that has fallen upon its surface from out the depths of space must be enormous. It certainly must enter largely into the composition of the soil and of the sedimentary rocks. Celestial dirt we may truly call it, star dust, in which we plant our potatoes and grain and out of which Adam was made, and every son of man since Adam — the divine soil in very fact, the garden of the Eternal, contributed to by the heavens above and all the vital forces below, incorruptible, forever purifying itself, clothing the rocky framework of the globe as with flesh and blood, making the earth truly a mother with a teeming fruitful womb, and her hills veritable mammary glands. The iron in the fruit and vegetables we eat, which thence goes into our blood, may, not very long ago, have formed a part of the cosmic dust that drifted for untold ages along the highways of planets and suns.

The soil underfoot, or that we turn with our plow, how it thrills with life or the potencies of life! What a fresh, good odor it exhales when we turn it with our spade or plow in spring! It is good. No wonder children and horses like to eat it!

How inert and dead it looks, yet what silent, potent fermentations are going on there — millions and trillions of minute organisms ready to further your scheme of agriculture or horticulture. Plant your wheat or your corn in it, and behold the miracle of a birth of a plant or a tree. How it pushes

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up, fed and stimulated by the soil, through the agency of heat and moisture! It makes visible to the eye the life that is latent or held in suspense there in the cool, impassive ground. The acorn, the chestnut, the maple keys, have but to lie on the surface of the moist earth to feel its power and send down rootlets to meet it.

From one point of view, what a ruin the globe is! — worn and crumbled and effaced beyond recognition, had we known it in its youth. Where once towered mountains are now only their stumps — low, fertile hills or plains. Shake down your great city with its skyscrapers till most of its buildings are heaps of ruins with grass and herbage growing upon them, and you have a hint of what has happened to the earth.

Again, one cannot but reflect what a sucked orange the earth will be in the course of a few more centuries. Our civilization is terribly expensive to all its natural resources; one hundred years of modern life doubtless exhausts its stores more than a millennium of the life of antiquity. Its coal and oil will be about used up, all its mineral wealth greatly depleted, the fertility of its soil will have been washed into the sea through the drainage of its cities, its wild game will be nearly extinct, its primitive forests gone, and soon how nearly bankrupt the planet will be!

There is no better illustration of the way decay

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and death play into the hands of life than the soil underfoot. The earth dies daily and has done so through countless ages. But life and youth spring forever from its decay; indeed, could not spring at all till the decay began. All the soil was once rock, perhaps many times rock, as the water that flows by may have been many times ice.

The soft, slow, aerial forces, how long and patiently they have worked! Oxygen has played its part in the way of oxidation and dioxidation of minerals. Carbon or carbonic acid has played its part, hydrogen has played its. Even granite yields slowly but surely to the action of rain-water. The sun is of course the great dynamo that runs the earth machinery and, through moisture and the air currents, reduces the rocks to soil. Without solar heat we should have no rain, and without rain we should have no soil. The decay of a mountain makes a hill of fertile fields. The soil, as we know it, is the product of three great processes — mechanical, chemical, and vital — which have been going on for untold ages. The mechanical we see in the friction of winds and waves and the grinding of glaciers, and in the destructive effects of heat and cold upon the rocks; the chemical in the solvent power of rain-water and of water charged with various acids and gases. The soil is rarely the color of the underlying rock from which it came, by reason of the action of the various gases of the atmosphere. Iron

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is black, but when turned into rust by the oxygen of the air, it is red.

The vital processes that have contributed to the soil we see going on about us in the decay of animal and vegetable matter. It is this process that gives the humus to the soil, in fact, almost humanizes it, making it tender and full of sentiment and memories, as it were, so that it responds more quickly to our needs and to our culture. The elements of the soil remember all those forms of animal and vegetable life of which they once made a part, and they take them on again the more readily. Hence the quick action of wood ashes upon vegetable life. Iron and lime and phosphorus that have once been taken up by growing plants and trees seem to have acquired new properties, and are the more readily taken up again.

The soil, like mankind, profits by experience, and grows deep and mellow with age. Turn up the cruder subsoil to the sun and air and to vegetable life, and after a time its character is changed; it becomes more gentle and kindly and more fertile.

All things are alike or under the same laws — the rocks, the soil, the soul of man, the trees in the forest, the stars in the sky. We have fertility, depth, geniality, in the ground underfoot, on the same terms upon which we have these things in human life and character.

We hardly realize how life itself has stored up

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life in the soil, how the organic has wedded and blended with the inorganic in the ground we walk upon. Many if not all of the sedimentary rocks that were laid down in the abysses of the old ocean, out of which our soil has been produced, and that are being laid down now, out of which future soils will be produced, were and are largely of organic origin, the leavings of untold myriads of minute marine animals that lived millions of years ago. Our limestone rocks, thousands of feet thick in places, the decomposition of which furnishes some of our most fertile soils, are mainly of plant and animal origin. The chalk hills of England, so smooth and plump, so domestic and mutton-suggesting, as Huxley says, are the leavings of minute creatures called *Globigerinæ*, that lived and died in the ancient seas in the remote past. Other similar creatures, *Radiolaria* and diatoms, have played an equally important part in contributing the foundation of our soils. Diatom earth is found in places in Virginia forty feet thick. The coral insects have also contributed their share to the soil-making rocks. Our marl-beds, our phosphatic and carbonaceous rocks, are all largely of animal origin. So that much of our soil has lived and died many times, and has been charged more and more during the geologic ages or eternities with the potencies of life.

Indeed, Huxley, after examining the discoveries of the *Challenger* expedition, says there are good

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grounds for the belief "that all the chief known constituents of the crust of the earth may have formed part of living bodies; that they may be the 'ash' of protoplasm."

This implies that life first appeared in the sea, and gave rise to untold myriads of minute organisms, that built themselves shells out of the mineral matter held in solution by the water. As these organisms perished, their shells fell to the bottom and formed the sedimentary rocks. In the course of ages these rocks were lifted up above the sea, and their decay and disintegration under the action of the elements formed our soil — our clays, our marls, our green sand — and out of this soil man himself is built up.

I do not wonder that the Creator found the dust of the earth the right stuff to make Adam of. It was half man already. I can easily believe that his spirit was evoked from the same stuff, that it was latent there, and in due time, under the brooding warmth of the creative energy, awoke to life.

If matter is eternal, as science leads us to believe, and creation and recreation a never-ending process, then the present world, with all its myriad forms of the organic and the inorganic, is only one of the infinite number of forms that matter must have assumed in past æons. The whole substance of the globe must have gone to the making of other globes such a number of times as no array of fig-

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ures could express. Every one of the sixty or more primary elements that make up our own bodies and the solid earth beneath us must have played the same part in the drama of life and death, growth and decay, organic and inorganic, that it is playing now, and will continue to play through an unending future.

This gross matter seems ever ready to vanish into the transcendental. When the new physics is done with it, what is there left but spirit, or something akin to it? When the physicist has followed matter through all its transformations, its final disguise seems to be electricity. The solid earth is resolvable into electricity, which comes as near to spirit as anything we can find in the universe.

Our senses are too dull and coarse to apprehend the subtle and incessant play of forces about us — the finer play and emanations of matter that go on all about us and through us. From a lighted candle, or gas-jet, or glowing metal shoot corpuscles or electrons, the basic constituents of matter, of inconceivable smallness — a thousand times smaller than an atom of hydrogen — and at the inconceivable speed of 10,000 to 90,000 miles a second. Think how we are bombarded by these bullets as we sit around the lamp or under the gas-jet at night, and are all unconscious of them! We are immersed in a sea of forces and potentialities of which we hardly dream. Of the scale of temperatures, from absolute

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zero to the heat of the sun, human life knows only a minute fraction. So of the elemental play of forces about us and over us, terrestrial and celestial — too fine for our apprehension on the one hand, and too large on the other — we know but a fraction.

The quivering and the throbbing of the earth under our feet in changes of temperature, the bendings and oscillations of the crust under the tread of the great atmospheric waves, the vital fermentations and oxidations in the soil — are all beyond the reach of our dull senses. We hear the wind in the treetops, but we do not hear the humming of the sap in the trees. We feel the pull of gravity, but we do not feel the medium through which it works. During the solar storms and disturbances all our magnetic and electrical instruments are agitated, but you and I are all unconscious of the agitation.

There are no doubt vibrations from out the depths of space that might reach our ears as sound were they attuned to the ether as the eye is when it receives a ray of light. We might hear the rush of the planets along their orbits, we might hear the explosions and uprushes in the sun; we might hear the wild whirl and dance of the nebulæ, where suns and systems are being formed; we might hear the "wreck of matter and the crush of worlds" that evidently takes place now and then in the abysms of space, because all these things must send through the ether impulses and tremblings that reach our

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planet. But if we felt or heard or saw or were conscious of all that was going on in the universe, what a state of agitation we should be in! Our scale of apprehension is wisely limited, mainly to things that concern our well-being.

But let not care and humdrum deaden us to the wonders and the mysteries amid which we live, nor to the splendors and the glories. We need not translate ourselves in imagination to some other sphere or state of being to find the marvelous, the divine, the transcendent; we need not postpone our day of wonder and appreciation to some future time and condition. The true inwardness of this gross visible world, hanging like an apple on the bough of the great cosmic tree, and swelling with all the juices and potencies of life, transcends anything we have dreamed of super-terrestrial abodes. It is because of these things, because of the vitality, spirituality, oneness, and immanence of the universe as revealed by science, its condition of transcending time and space, without youth and without age, neither beginning nor ending, neither material nor spiritual, but forever passing from one into the other, that I was early and deeply impressed by Walt Whitman's lines:—

“There was never any more inception than there is now,
Nor any more youth or age than there is now;
And will never be any more perfection than there is now,
Nor any more heaven or hell than there is now.”

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And I may add, nor any more creation than there is now, nor any more miracles, or glories, or wonders, or immortality, or judgment days, than there are now. And we shall never be nearer God and spiritual and transcendent things than we are now. The babe in its mother's womb is not nearer its mother than we are to the invisible sustaining and mothering powers of the universe, and to its spiritual entities, every moment of our lives.

The doors and windows of the universe are all open; the screens are all transparent. We are not barred or shut off; there is nothing foreign or unlike; we find our own in the stars as in the ground underfoot; this clod may become a man; yon shooting star may help redden his blood.

Whatever is upon the earth is of the earth; it came out of the divine soil, beamed upon by the fructifying heavens, the soul of man not less than his body.

I never see the spring flowers rising from the mould, or the pond-lilies born of the black ooze, that matter does not become transparent and reveal to me the working of the same celestial powers that fashioned the first man from the common dust.

Man's mind is no more a stranger to the earth than is his body. Is not the clod wise? Is not the chemistry underfoot intelligent? Do not the roots of the trees find their way? Do not the birds know

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their times and seasons? Are not all things about us filled to overflowing with mind-stuff? The cosmic mind is the earth mind, and the earth mind is man's mind, freed but narrowed, with vision but with erring reason, conscious but troubled, and — shall we say? — human but immortal.

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I

HOW few persons can be convinced of the truth of that which is repugnant to their feelings! When Darwin published his conclusion that man was descended from an apelike ancestor who was again descended from a still lower type, most people were shocked by the thought; it was intensely repugnant to their feelings. Carlyle, for instance, treated the proposition with contempt. He called it the "gospel of dirt." "A good sort of man," he said, "is this Darwin, and well meaning, but with very little intellect." Huxley tells of seeing the old man one day upon the street, and of crossing over to greet him. Carlyle looked up and said, "You're Huxley, are n't you? the man who says we are all descended from monkeys," and went on his way. It would be interesting to know just what Carlyle thought we were descended from. Could he, or did he, doubt at all that if he were to go back a few thousand years over his own line of descent, he would come upon rude savage men, who used stone implements, and lived in caves or rude huts, who had neither letters nor arts, and with whom might did indeed make right, and that back of these he would find

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still more primitive races, and that these too had their still more savage and bestial forbears? When started on the back track of his own race, where could he stop? Could he stop anywhere? The neolithic man stands on the shoulders of the paleolithic, and he on a still lower human or semi-human form, till we come to a manlike ape or an apelike man, living in trees and subsisting on roots and nuts and wild fruits. Every child born to-day, by the grip of its hands, the strength of its arms, and the weakness of its legs, hints of those far-off arboreal ancestors. Carlyle must also have known that in his fetal or prenatal life there was a time when his embryo could not have been distinguished from that of a dog, to say nothing of a monkey. Was this fact also intolerable to him?

It must be a bitter pill to persons of Carlyle's temperament to have to accept the account of their own human origin; that the stork legend of the baby is, after all, not good natural history. The humble beginning of each of us is not one that appeals to the imagination, nor to the religious sentiment, nor to our love of the mysterious and the remote, yet the evidence in favor of its truth is pretty strong.

In fact, the Darwinian theory of the origin of man differs from the popular one just as the natural history of babies as we all know it differs from the account in the nursery legends, and gives about

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the same shock to our sensibilities and our pride of origin.

One of the hardest lessons we have to learn in this life, and one that many persons never learn, is to see the divine, the celestial, the pure, in the common, the near at hand — to see that heaven lies about us here in this world. Carlyle's gospel of dirt, when examined closely, differs in no respect from a gospel of star dust. Why, we have invented the whole machinery of the supernatural, with its unseen spirits and powers good and bad, to account for things, because we found the universal everyday nature too cheap, too common, too vulgar. We have had to cap the natural with the supernatural to satisfy our love for the marvelous and the inexplicable. As soon as a thing is brought within our ken and the region of our experience, it seems to lose caste and be cheapened. I am at a loss how to account for this mythopoetic tendency of ours, but what a part it has played in the history of mankind, and what a part it still plays — turning the light of day into a mysterious illusive and haunted twilight on every hand! It would seem as if it must have served some good purpose in the development of the race, but just what is not so easy to point out as the evil it has wrought, the mistakes and self-delusions it has given rise to. One may probably say that in its healthy and legitimate action it has given rise to poetry and to art and to the many

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escapes which the imagination provides us from the hard and wearing realities of life. Its implacable foe is undoubtedly the scientific spirit — the spirit of the now and the here, that seeks proof and finds the marvelous and the divine in the ground underfoot; the spirit that animated Lyell and opened his eyes to the fact that the forces and agencies at work every day around us were adequate to account for the tremendous changes in the earth's surface in the past; that animated Darwin and led him to trace the footsteps of the creative energy in the natural life of plants and animals to-day; that animated Huxley and filled him with such righteous wrath at the credulity of his theological brethren; and that animates every one of us when we clinch a nail, or stop a leak, or turn a thing over and look on the other side, and apply to practical affairs the touchstone of common sense.

That man is of divine origin in a sense that no other animal is, is a conviction dear to the common mind. It was dear to the mind of Carlyle, it chimed in well with his distrust of the present, his veneration of the past, and his Hebraic awe and reverential fear before the mysteries of the universe. While Darwin's attitude of mind toward outward things was one of inquiry and thirst for exact knowledge, Carlyle's was one of reverence and wonder. He was more inclined to worship where Darwin was moved to investigate. Darwin, too, felt the

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presence of the great unknown, but he sought solace in the knowable of the physical world about him, while Carlyle sought solace in the moral and intellectual world, where his great mythopoetic faculty could have free swing.

We teach and we preach that God is in everything from the lowest to the highest, and that all things are possible with him, and yet practically we deny that he is in the brute, and that it is possible man should have had his origin there.

I long ago convinced myself that whatever is on the earth and shares its life is of the earth, and, in some way not open to me, came out of the earth, the highest not less than the humblest creature at our feet. I like to think of the old weather-worn globe as the mother of us all. I like to think of the ground underfoot as plastic and responsive to the creative energy, vitally related to the great cosmic forces, a red corpuscle in the life current of the Eternal, and that man, with all his high-flying dreams and aspirations, his arts, his bibles, his religions, his literatures, his philosophies — heroes, saints, martyrs, sages, poets, prophets — all lay folded there in the fiery mist out of which the planet came. I love to make Whitman's great lines my own: —

"I am an acme of things accomplished, and I an endorser of
things to be."

My feet strike an apex of the apices of the stairs,

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On every step bunches of ages, and larger bunches between
the steps,
All below duly traveled, and still I mount and mount.

“ Rise after rise bow the phantoms behind me,
Afar down I see the huge first Nothing — I know I was even
there,
I waited unseen and always, and slept through the lethargic
mist,
And took my time, and took no hurt from the fetid carbon.

“ Long I was hugged close — long and long.
Immense have been the preparations for me,
Faithful and friendly the arms that have helped me.
Cycles ferried my cradle, rowing and rowing like cheerful boat-
men,
For room to me stars kept aside in their own rings,
They sent influences to look after what was to hold me.

“ Before I was born out of my mother generations guided me,
My embryo has never been torpid — nothing could overlay it.
For it the nebula cohered to an orb,
The long, slow strata piled to rest it in,
Vast vegetables gave it sustenance,
Monstrous sauroids transported it in their mouths and depos-
ited it with care.
All forces have been steadily employed to complete and delight
me,
Now I stand on this spot with my Soul.”

II

The material, the carnal, the earthy, has been so
long under the ban, so long associated in our minds
with that which hinders and degrades, and as the
source and province of evil, that it will take sci-

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ence a long time to redeem it and lift it again to its proper place.

It jars upon our sensibilities and disturbs our preconceived notions to be told that the spiritual has its root in the carnal, and is as truly its product as the flower is the product of the roots and the stalk of the plant. The conception does not cheapen or degrade the spiritual, it elevates the carnal, the material. To regard the soul and body as one, or to ascribe to consciousness a physiological origin, is not detracting from its divinity, it is rather conferring divinity upon the body. One thing is inevitably linked with another — the higher forms with the lower forms, the butterfly with the grub, the flower with the root, the food we eat with the thought we think, the poem we write, or the picture we paint, with the processes of digestion and nutrition. How science has enlarged and ennobled and purified our conception of the universe; how it has cleaned out the evil spirits that have so long terrified mankind, and justified the verdict of the Creator: "and behold it was good"! With its indestructibility of matter, its conservation of energy, its inviolability of cause and effect, its unity of force and elements throughout sidereal space, it has prepared the way for a conception of man, his origin, his development, and in a measure his destiny, that at last makes him at home in the universe.

How much more consistent it is with what we

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know of the unity of nature to believe that one species should have come through another, that man should have come through the brute rather than have been grafted upon him from without. Unfolding and ever unfolding, upward and onward, from the lower to the higher, from the simple to the complex — that has been the course of organic evolution from the first.

One thinks of the creative energy as working along many lines, only one of which eventuated in man; all the others fell short, or terminated in lower forms. Hence while we think of man as capable of, and destined to, still higher development, we look upon the lower orders as having reached the end of their course, and conclude there is no to-morrow for them.

The anthropoid apes seem indeed like preliminary studies of man, or rejected models of the great inventor who was blindly groping his way to the higher form. The ape is probably our ancestor in no other sense than this. Nature seems to have had man in mind when she made him, but evidently she lost interest in him, humanly speaking, and tried some other combination. The ape must always remain an ape. Some collateral branch doubtless gave birth to a higher form, and this to a still higher, till we reach our preglacial forbears. Then some one branch or branches distanced all others, leaving rude tribes by the way in whom

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development seemed arrested, till we reach the dawn of history.

The creative energy seems ever to have been pushing out and on, and yet ever leaving a residue of forms behind. The reptiles did not all become birds, nor the invertebrates all become vertebrates, nor the apes all become men, nor the men all become Europeans. Every higher form has a base or background of kindred lower forms out of which it seems to have emerged, and to which it now and then shows a tendency to revert. And this is the order of nature everywhere, in our own physiology and psychology not less than in the evolution of the forms of life. Do not our highest ideals have their rise and foundation in sensation and experience? There is no higher without first the lower, and the lower does not all become the higher.

The blood relationship between man and the anthropoid apes, as shown in the fact that human blood acts poisonously upon and decomposes the blood of the lower apes and other mammals, but is harmless to the blood of the anthropoid apes and affiliates with it, is very significant. It convinces like a demonstration. Transfer the blood of the dog to the fox or the wolf, or *vice versa*, and all goes well; they are brothers. Transfer the blood of the dog to the rabbit, or *vice versa*, and a struggle for life immediately takes place. The serum of one

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blood destroys the cells of the other. This fact confirms Huxley's statement that the anatomical difference between man and the anthropoid apes is less than the corresponding difference between the latter and the lower apes.

III

One thing we may affirm about the universe — it is logical; the conclusion always follows from the premises.

The lesson which life repeats and constantly enforces is "look under foot." You are always nearer the divine and the true sources of your power than you think. The lure of the distant and the difficult is deceptive. The great opportunity is where you are. Do not despise your own place and hour. Every place is under the stars, every place is the centre of the world. Stand in your own doorway and you have eight thousand miles of solid ground beneath you, and all the sidereal splendors overhead. The morning and the evening stars are no more in the heavens and no more obedient to the celestial impulses than the lonely and time-scarred world we inhabit. How the planet thrills and responds to the heavenly forces and occurrences we little know, but we get an inkling of it when we see the magnetic needle instantly affected by solar disturbances.

Look under foot. Gold and diamonds and all

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precious stones come out of the ground; they do not drop upon us from the stars, and our highest thoughts are in some way a transformation or a transmutation of the food we eat. The mean is the divine if we make it so. The child surely learns that its father and mother are the Santa Claus that brought the gifts, though the discovery may bring pain; and the man learns to see providence in the great universal forces of nature, in the winds and the rain, in the soil underfoot and in the cloud overhead. What these forces in their orderly rounds do not bring him, he does not expect. The farmer hangs up his stocking in the way of empty bins and barns, and he knows well who or what must fill them. The Santa Claus of the merchant, the manufacturer, the inventor, is the forces and conditions all about us in every-day operation. When the lightning strikes your building or the trees on your lawn, you are at least reminded that you do not live in a corner outside of Jove's dominions, you are in the circuit of the great forces. If you are eligible to bad fortune where you stand, you are equally eligible to good fortune there. The young man who went West did well, but the young man who had the Western spirit and stayed at home did equally well. To evoke a spark of fire out of a flint with a bit of steel is the same thing as evoking beautiful thoughts from homely facts. How hard it is for us to see the heroic in an act of our neighbor!

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IV

What a burden science took upon itself when it sought to explain the origin of man! Religion or theology takes a short cut and makes quick work of it by regarding man as the result of the special creative act of a supernatural Being. But science takes a long and tedious and hazardous way around through the lowest primordial forms of life. It seeks to trace his germ through the abyss of geologic time, where all is dim and mysterious, through countless cycles of waiting and preparation, where the slow, patient gods of evolution cherished it and passed it on, through the fetid carbon, through the birth and decay of continents, through countless interchanges and readjustments of sea and land, through the clash and warring of the cosmic forces, through good and evil report, through the fish and the reptile, through the ape and the orang, up to man — from the slime at the bottom of the primordial ocean up to Jesus of Nazareth. Surely one may say with Whitman, —

“Immense have been the preparations for me,
Faithful and friendly the arms that have helped me.”

It took about one hundred thousand feet of sedimentary rock, laid down through hundreds of millions of years in the bottom of the old seas, all probably the leavings of minute forms of life, to make a foundation upon which man could appear.

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His origin as revealed by science fills and appalls the imagination: as revealed by theology it simply baffles and dumfounds one. Science deepens the mystery while yet it gives the reason and the imagination something to go upon; it takes us beyond soundings, but not beyond the assurance that cause and effect are still continuous there beneath us. I like to think that man has traveled that long, adventurous road, that the whole creation has pulled together to produce him. It is a road, of course, beset with pain and anguish, beset with ugly and repellent forms, beset with riot and slaughter; it leads through jungle and morass, through floods and cataclysms, through the hells of the Mesozoic and the Cenozoic periods, but it leads ever upward and onward.

The manward impulse in creation has doubtless been checked many times, but never lost; all forms conspired to further it, and it seemed to have taken the push and the aspiration out of each order as it passed on, dooming it henceforth to a round of life without change or hope of progress, leaving the fish to continue fish, the reptiles to continue reptiles, the apes to continue apes; it took all the heart and soul of each to feed and continue the central impulse that was to eventuate in man.

I fail to see why our religious brethren cannot find in this history or revelation as much room for creative energy, as large a factor of the mysterious and

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superhuman, as in the myth of Genesis. True it is that it fixes our attention upon this world and upon forces with which we are more or less familiar, but it implies an element or a power before which we stand helpless and dumb. What fathered this man-impulse, what launched this evolutionary process, what or who stamped upon the first protoplasm the aspiration to be man, and never let that aspiration sleep through all the tremendous changes of those incalculable geologic ages? What or who first planted the seed of the great biological tree, and determined all its branchings and the fruit it should bear? If you must have a God, either apart from or imminent in creation, it seems to me that there is as much need of one here as in the Mosaic cosmology. The final mystery cannot be cleared up. We can only drive it to cover. How the universe came to be what it is, and how man came to be man, who can tell us?

That somewhere in my line of descent was an ancestor that lived in trees and had powerful arms and weaker legs, that his line began in a creature that lived on the ground, and his in one that lived in the mud, or in the sea, and his, or its, sprang from a germ at the bottom of the sea, but deepens the mystery of the being that is now here and can look back and speculate over the course he has probably come; it only directs attention to ugly facts, to material things, to the every-day process

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of evolution, instead of to the far away, the unknown, or the supernatural.

How the organic came to bud and grow from the inorganic, who knows? Yet it must have done so. We seem compelled to think of an ascending series from nebular matter up to the spirituality of man, each stage in the series resting upon or growing out of the one beneath it. Creation or development must be continuous. There are and can be no breaks. The inorganic is already endowed with chemical and molecular life. The whole universe is alive, and vibrates with impulses too fine for our dull senses; but in chemical affinity, in crystallization, in the persistence of force, in electricity, we catch glimpses of a kind of vitality that is preliminary to all other. I never see fire burn, or water flow, or the frost-mark on the pane, that I am not reminded of something as mysterious as life. How alive the flame seems, how alive the water, how marvelous the arborescent etchings of the frost! Is there a principle of fire? Is there a principle of crystallization? Just as much as there is a principle of life. The mind, in each case, seems to require something to lay hold of as a cause. Why these wonderful star forms of the snowflake? Why these exact geometric forms of quartz crystals? The gulf between disorganized matter and the crystal seems to me as great as that between the organic and the inor-

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ganic. If we did not every day witness the passage, we could not believe it. The gulf between the crystal and the cell we have not seen cleared, and man has not yet been able to bridge it, and may never be, but it has been bridged, and I dare say without any more miracle than hourly goes on around us. The production of water from two invisible gases is a miracle to me. When water appeared (what made it appear?) and the first cloud floated across the blue sky, life was not far off, if it was not already there. Some morning in spring when the sun shone across the old Azoic hills, at some point where the land and sea met, life began — the first speck of protoplasm appeared. Call it the result of the throb or push of the creative energy that pervades all things, and whose action is continuous and not intermittent, since we are compelled to presuppose such energy to account for anything, even our own efforts to account for things. An ever active vital force pervades the universe, and is felt and seen in all things, from atomic attraction and repulsion up to wheeling suns and systems. The very processes of thought seem to require such premises to go upon. There is a reason for the universe as we find it, else man's reason is a delusion, and delusion itself is a meaningless term. The uncaused is unthinkable; thought can find neither beginning nor ending to the universe because it cannot find the primal cause. Can

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we think of a stick with only one end? We have to if we compass time in thought, or space, either.

V

Given atomic motion, chemical affinity — this hunger or love of the elements for one another — crystallization, electricity, radium, the raining upon us of solar and sidereal influences, the youth of the earth, and the whole universe vibrating with the cosmic creative energy, the beginning of life, the step from the inorganic to the organic, is not so hard to conceive. In a dead universe this would be hard, but we have a universe throbbing with cosmic life and passion to begin with. It is impossible for me to think of anything as uncaused, and in trying to figure to myself this beginning of life I have to postulate this universal creative energy that pervades the worlds as animating the atoms and causing them to combine so as to produce the primordial protoplasm. Then when the first cell divides and becomes two, I have to think of an inherent something that prompts the act, and so on all the way up.

I cannot conceive of crystallization, this precise and invariable arrangement of certain elements, nor of the invariable chemical compounds, without postulating some inner force, or will, or tendency that determines them. I cannot conceive of an atom of carbon, or oxygen, or hydrogen as doing anything of itself. It must be alive, and this life

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and purpose pervades the universe. This inability on my part may be only the limitation of thought. I know there are things I cannot conceive of that are yet true. I cannot conceive how the sky is still overhead at the South Pole as at the North, because one position to my senses is the reverse of the other, and I am compelled to think of up and down as the same. I cannot think how anything can begin, because time, like matter, is infinitely divisible, and there always remains a mathematical fragment of time between the not beginning and the beginning. The conditions of thought are such that I do not see how one can think of one's self, that is, be object and subject at the same instant of time — jump down one's own throat, so to speak — and yet we seem to manage to do it.

VI

If life can finally be explained in terms of physics and chemistry, that is, if the beginning of life upon the globe was no new thing, the introduction of no new principle, but only the result of a vastly more complex and intimate play and interaction of the old physico-chemical forces of the inorganic world, then the gulf that is supposed to separate the two worlds of living and non-living matter virtually disappears: the two worlds meet and fuse. We shall probably in time have to come to accept this view — the view of the mechanico-chemical theory of life.

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It is in a line with the whole revelation of science, so far — the getting rid of the miraculous, the unknowable, the transcendental, and the enhancing of the potency and the mystery of things near at hand that we have always known in other forms. It is at first an unpalatable truth, like the discovery of the animal origin of man, or that consciousness and all our fine thoughts and aspirations are the result of molecular action in the brain; or like the experience of the child when it discovers that its father or mother is the Santa Claus that filled its stockings. Science is constantly bringing us back to earth and to the ground underfoot. Our dream of something far off, supernatural, vanishes. We lose the God of a far-off heaven, and find a God in the common, the near, always present, always active, always creating the world anew. Science thus corrects our delusions and vague superstitions, and brings us back near home for the key we had sought afar. We shall probably be brought, sooner or later, to accept another unpalatable theory, that of the physical origin of the soul, that it is not of celestial birth except as the celestial and terrestrial are one. This is really only taking our religious teachers at their word, that God is here, as constant and as active in the commonest substance we know as in the highest heaven. Science finds the beginning of something like conscious intelligence in the first unicellular life, the first pro-

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tozoön. When two or more cells unite to form a metazoön, it finds a higher and more complex form of intelligence. In the brain of man it finds a confraternity of millions of simple cells, each with a life and intelligence of its own, but when united and coöperating, the intelligence of all *pooled*, as it were, we have the mind and personality of man as the result. This fact leaves no room for the notion that the mind or soul is an entity apart from the organ which it uses. It seems, on the contrary, in some mysterious way to be the result of the multicellular life of the nervous system. Thus we do not banish the mystery of the soul, we only bring it nearer home. We disprove a fable, and are then confounded by the fact that lurks under it. And this proves true in all attempts at ultimate explanations of the phenomena of this world.

It seems as if we saw the hint of prophecy of the vegetable in the mineral — in this growth of crystals, in these arborescent forms of the frost on the pane or on the flagging-stones. One may see most wonderful tree and fern forms upon the pavement, with clean open spaces between them, as much so as in a wood, an endless variety of them. A French chemist has lately produced by inorganic compounds the growth of something like a plant with roots, stem, branches, leaves, buds — a mineral plant, as if the type of the plant already existed in the soil. Yes, the inorganic is dreaming of the

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organic. And the plant in its cell structure, in its circulation, in its intelligence, or in its ingenious devices to get on in the world is dreaming of the animal, and the animal is dreaming of the spiritual, and the spirituality of man touches the spirituality of the cosmos, and thus the circle is complete.

VII

So far as science can find out, *sentience* is a property of matter which is evolved under certain conditions, and though science itself has not yet been able to reproduce these conditions, it still believes in the possibility. If life was not potential in the inorganic world, how is it possible to account for it? It is not a graft, it is more like a begetting. Nature does not work by prefixes and suffixes, but by unfolding and ever unfolding, or developing out of latent innate powers and possibilities; — an inward necessity always working, but never an external maker. It is no help to fancy that life may have been brought to the earth by a falling meteorite from some other sphere. How did life originate upon that other sphere? It must have started here as surely as fire started here. We feign that Prometheus stole the first fire from heaven, but it sleeps here all about us, and can be evoked any time and anywhere. It sleeps in all forms of force. A falling avalanche of rocks turns to flame; the meteor in the air becomes a torch;

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the thunderbolt is a huge spark. So life, no doubt, slept in the inorganic, and was started by the reverse of friction, namely, by brooding.

When the earth becomes lifeless again, as it surely must in time, then the cycle will be repeated, a collision will develop new energy and new worlds, and out of this newness will again come life.

It is highly probable that a million years elapsed between the time when the ancestor of man began to assume the human form and the dawn of history. Try to think of that time and of the struggle of this creature upward; of the pain, the suffering, the low bestial life, the warrings, the defeats, the slow, infinitely slow gains, of his deadly enemies in other animals, of the repeated changes of climate of the northern hemisphere from subtropical to subarctic — the land at one time for thousands of years buried beneath an ice sheet a mile or more thick, followed by a cycle of years of almost tropical warmth even in Greenland — and all of this before man had yet got off of “all fours,” and stood upright and began to make rude tools and rude shelters from the storms. The Tertiary period, early in which the first rude ancestor of man seems to have appeared, is less than one week of the great geologic year of the earth’s history — a week of about five days. These days the geologists have named Eocene, Oligocene, Miocene, Pliocene, and Pleistocene, each one of these days covering, no

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doubt, a million years or more. The ancestor of man probably took on something like the human form on the third, or Miocene, day. The other and earlier fifty or more weeks of the great geologic year gradually saw the development of the simpler forms of life, till we reach the earliest mammals and reptiles in the Permian, about the forty-eighth or forty-ninth week of the great year. The laying down of the coal measures, Huxley thinks, must have taken six millions of years. Well, the Lord allowed himself enough time. Evidently he was in no hurry to see man cutting his fantastic tricks here upon the surface of the planet. A hundred million years, more or less, what of it? Did the globe have to ripen all those cycles upon cycles, like the apple upon the tree? bask in the sidereal currents, work and ferment in the sea of the hypothetical ether before the gross matter could evolve the higher forms of life? Probably every unicellular organism that lived and died in the old seas helped prepare the way for man, contributed something to the fund of vital energy of the globe upon which man was finally to draw.

How life has had to adjust itself to the great cosmic changes! The delays must have been incalculable. The periodic refrigeration of the northern hemisphere, which brought on the ice age several times during each one of the Eocene and Miocene days, must have delayed the development of life as we know it, enormously.

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VIII

From nebula to nebula — these are the hours struck by the clock of eternity: from the dissipation of the solar systems into nebular gas by their falling together to their condensation again into suns and worlds by the action of physical laws — thousands of millions of years in each hour, and the hours infinite in number. This is a hint of eternity. How many times, then, there must have been a world like this evolved in the course of this running down and winding up of the great clock, with beings like these we now behold! how many such worlds and such beings there must now be in the universe, and have always been! Can you think of the number? Not till you can think of infinity. The duration of life upon the globe, to say nothing of man's little span, is hardly a tick of this clock of eternity, and the repetition of the birth and dissipations of systems is well symbolized by the endless striking or ticking of a clock.

Then sooner or later comes the thought, What is it all for? and from the great abysm comes back the echo, "What for?" Is it our human limitations, the discipline of this earthly life, when we have to count the cost and ask what it is for, that makes us put the question to the Infinite? When the cosmic show is over, what is the gain? When our universe is again a blank, who or what will have

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reaped the benefit? Will the moral order which has been so slowly and painfully evolved, and which so many souls have struggled to live up to, still go on? Where? with whom? I seem to see dimly that you cannot bring the Infinite to book, that you cannot ask, "What for?" of the All, — of that which has neither beginning nor end, neither centre nor circumference, neither fulfillment nor design, which knows neither failure nor success, neither loss nor gain, and which is complete in and of itself.

We are tied to the sphere, its laws shape our minds, we cannot get away from it and see it in perspective; away from it there is no direction; at either pole on its surface there is the contradiction of the sky being always overhead. We are tied to the Infinite in the same way. We are part of it, but may not measure it. Our boldest thought comes back like a projectile fired into the heavens — the curve of the infinite sphere holds us. I know I am trying to say the unsayable. I would fain indicate how human and hopeless is our question, "What for?" when asked of the totality of things. There is no totality of things. To say that there is, does not express it. To say there is not, does not express it. To say that the universe was created, does not express the mystery; to say that it was not created, but always existed, does not express it any nearer. To say that the heavens are overhead is only half the truth; they are underfoot also.

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Down is toward the centre of the earth, but go on through and come out at the surface on the other side, and which way is down then?

The Unspeakable will not be spoken.

In the light of science we must see that life and progress and evolution and the moral order must go on and on somewhere, that the birth of systems and the evolution of planets must and does continue, and always has continued; that if one sun fades, another blazes out; that as there must have been an infinite number (how can there be an infinite number? where is the end of the endless?) of worlds in the past, so there will be an infinite number in the future; that if the moral order and the mathematical order and the intellectual order disappear from one planet, they will appear in due time on another.

All that which in our limited view of nature we call waste and delay — how can such terms apply to the Infinite? Can we ever speak truly of the Infinite in terms of the finite? To be sure, we have no other terms, and can never have. Then let us be silent and — reverent.

XII

AN OUTLOOK UPON LIFE

I

THIS chapter, with its personal and autobiographical note, seems to call for some word of explanation. A few years since, a magazine editor asked me, as he asked others, to tell his readers something of what life meant to me, basing the paper largely upon my own personal experiences. The main part of the following essay was the result. The paper was so well received by a good many readers that, with some additions, I have decided to include it in this collection.

I have had a happy life, and there is not much of it I would change if I could live it over again. I think I was born under happy stars, with a keen sense of wonder, which has never left me, and which only becomes jaded a little now and then, and with no exaggerated notion of my own deserts. I have shared the common lot, and have found it good enough for me. Unlucky is the man who is born with great expectations, and who finds nothing in life quite up to the mark.

One of the best things a man can bring into the world with him is natural humility of spirit. About

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the next best thing he can bring, and they usually go together, is an appreciative spirit — a loving and susceptible heart. If he is going to be a reformer and stir up things, and slay the dragons, he needs other qualities more. But if he is going to get the most out of life in a worthy way, if he is going to enjoy the grand spectacle of the world from first to last, then he needs his life pitched in a low key and well attuned to common universal things. The strained, the loud, the far-fetched, the extravagant, the frenzied — how lucky we are to escape them, and to be born with dispositions that cause us to flee from them!

I would gladly chant a pæan for the world as I find it. What a mighty interesting place to live in! If I had my life to live over again, and had my choice of celestial abodes, I am sure I should take this planet, and I should choose these men and women for my friends and companions. This great rolling sphere with its sky, its stars, its sunrises and sunsets, and with its outlook into infinity — what could be more desirable? What more satisfying? Garlanded by the seasons, embosomed in sidereal influences, thrilling with life, with a heart of fire and a garment of azure seas, and fruitful continents — one might ransack the heavens in vain for a better or a more picturesque abode. As Emerson says, it is “well worth the heart and pith of great men to subdue and enjoy it.”

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O to share the great, sunny, joyous life of the earth! to be as happy as the birds are! as contented as the cattle on the hills! as the leaves of the trees that dance and rustle in the wind! as the waters that murmur and sparkle to the sea! To be able to see that the sin and sorrow and suffering of the world are a necessary part of the natural course of things, a phase of the law of growth and development that runs through the universe, bitter in its personal application, but illuminating when we look upon life as a whole! Without death and decay, how could life go on? Without what we call sin (which is another name for imperfection) and the struggle consequent upon it, how could our development proceed? I know the waste, the delay, the suffering in the history of the race are appalling, but they only repeat the waste, the delay, the conflict through which the earth itself has gone and is still going, and which finally issues in peace and tranquillity. Look at the grass, the flowers, the sweet serenity and repose of the fields — at what a price it has all been bought, of what a warring of the elements, of what overturnings, and pulverizings and shiftings of land and sea, and slow grindings of the mills of the gods of the fore-world it is all the outcome!

The agony of Russia at the present time (1904), the fire and sword, the snapping of social and political ties, the chaos and destruction that seem imminent — what is it but a geologic upheaval, the price that

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must be paid for law and order on a permanent basis? We deplore the waste and the suffering, but these things never can be eliminated from the processes of evolution. As individuals we can mitigate them; as races and nations we have to endure them. Waste, pain, delay—the gods smile at these things; so that the game goes on, that is enough. How many thousand centuries of darkness and horror lie between the man of to-day and the low animal ancestor from which he sprang! Who can picture the sufferings and the defeats! But here we are, and all that terrible past is forgotten, is, as it were, the soil under our feet.

Our fathers were cheered and sustained by a faith in special providences — that there was a Supreme Power that specially interested itself in man and his doings, and that had throughout the course of history turned the adverse currents in his favor. It is certain that all things have worked together for the final good of the race as a whole, otherwise it would have disappeared from the face of the earth. But Providence does things by wholesale. It is like the rain that falls upon the sea and the land equally, upon the just and the unjust, where it is needed and where it is not needed; and the evolution of the life of the globe, including the life of man, has gone on and still goes on, because, in the conflict of forces, the influences that favored life and forwarded it have in the end triumphed.

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Our good fortune is not that there are or may be special providences and dispensations, as our fathers believed, by which we may escape this or that evil, but our good fortune is that we have our part and lot in the total scheme of things, that we share in the slow optimistic tendency of the universe, that we have life and health and wholeness on the same terms as the trees, the flowers, the grass, the animals have, and pay the same price for our well being, in struggle and effort, that they pay. That is our good fortune. There is nothing accidental or exceptional about it. It is not by the favor or disfavor of some god that things go well or ill with us, but it is by the authority of the whole universe, by the consent and coöperation of every force above us and beneath us. The natural forces crush and destroy man when he transgresses them, as they destroy or neutralize one another. He is a part of the system of things, and has a stake in every wind that blows and cloud that sails. It is to his final interest, whether he sees it or not, that water should always do the work of water, and fire do the work of fire, and frost do the work of frost, and gravity do the work of gravity, though they destroy him ("Though he slay me, yet will I trust him"), rather than that they should ever fail. In fact, he has his life and keeps it only because the natural forces and elements are always true to themselves, and are no respecters of persons.

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We should not be here blustering around and sitting in judgment upon the ways of the Eternal, had not the ways of the Eternal been without variableness, or shadow of turning. If we or our fortunes go down prematurely beneath the currents, it is because the currents are vital, and do never and can never cease nor turn aside. The weakest force must give way, and the rotten timber break before the sound. We may fancy that there might be a better universe, but we cannot conceive of a better because our minds are the outcome of things as they are, and all our ideas of value are based upon the lessons we learn in this world.

Nature is as regardless of a planet or a sun as of a bubble upon the river, has one no more at heart than the other. How many suns have gone out? How many planets have perished? If the earth should collide with some heavenly body to-day and all its life be extinguished, would it not be just like spendthrift Nature? She has infinite worlds left, and out of old she makes new. You cannot lose or destroy heat or force, nor add to them, though you seem to do so. Nature wins in every game because she bets on both sides. If her suns or systems fail, it is, after all, her laws that succeed. A burnt-out sun vindicates the constancy of her forces.

As individuals we suffer defeat, injustice, pain, sorrow, premature death; multitudes perish to

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fertilize the soil that is to grow the bread of other multitudes; thousands but make a bridge of their dead bodies over which other thousands are to pass safely to some land of promise. The feeble, the idiotic, the deformed, seem to suffer injustice at the hands of their maker; there is no redress, no court of appeal for them; the verdict of natural law cannot be reversed. When the current of life shrinks in its channel, there are causes for it, and if these causes ceased to operate, the universe would go to pieces; but the individual whose measure, by reason of these causes, is only half full pays the price of the sins or the shortcomings of others; his misfortune but vindicates the law upon which our lives are all strung as beads upon a thread.

In an orchard of apple trees some of the fruit is wormy, some scabbed, some dwarfed, from one cause and another; but Nature approves of the worm, and of the fungus that makes the scab, and of the aphid that makes the dwarf, just as sincerely as she approves of the perfect fruit. She holds the stakes of both sides; she wins, whoever loses. An insect stings a leaf or a stem, and instantly all the forces and fluids that were building the leaf turn to building a home for the young of the insect; the leaf is forgotten, and only the needs of the insect remembered, and we thus have the oak gall and the hickory gall and other like abnormalities. The

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cancer that is slowly eating a man up — it too is the result of a vital process just as much as is the life it is destroying. Contagion, infection, pestilence, illustrate the laws of life. One thing devours or destroys another — the parasite destroys its host, the rust destroys the wheat or the oats, the vermin destroy the poultry, and so forth; still the game of life goes on, and the best wins, if not to-day, then to-morrow, or in ten thousand years. In the meantime, struggle, pain, defeat, death, come in; we suffer, we sorrow, we appeal to the gods. But the gods smile and keep aloof, and the world goes blundering on because there are no other conditions of progress. Evil follows good as its shadow; it is inseparable from the constitution of things. It shades the picture, it affords the contrast, it gives the impetus. The good, the better, the best — these are defined to us, and made to entice us by their opposites. We never fully attain them because our standards rise as we rise; what satisfied us yesterday will not satisfy us to-day. Peace, satisfaction, true repose, come only through effort, and then not for long. I love to recall Whitman's words, and to think how true they are both for nations and for individuals: —

“Now understand me well —

It is provided in the essence of things, that from any fruition of success, no matter what, shall come forth something to make a greater struggle necessary.”

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II

Life means such different things to different men and to different generations of men; its values shift from age to age and from country to country. Think what it meant to our Puritan forefathers, the early settlers of New England — freedom of religious opinion, and to worship God in their own way. This was the paramount interest and value of life. To secure this, they were ready to make any sacrifice — friends, home, property, country — and to brave hardship and dangers to the end of their lives. In those days the religious idea pressed heavily upon the minds of men, and the main concern of life related to the other world. We in our time can hardly realize the absolute tyranny of religious prepossessions that the minds of our fathers were under, and that the minds of men were under through all the Middle Ages.

Huxley in his old age said: "It is a great many years since at the outset of my career I had to think seriously what life had to offer that was worth having. I came to the conclusion that the chief good for me was freedom to learn, think, and say what I pleased, when I pleased." This was the old Puritan spirit cropping out again, in quite a different field, and concerned with the truth as it is related to this world, quite irrespective of its possible bearing upon the next.

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The value of life to Huxley lay in the opportunity to give free play to that truth-loving mind of his, no matter where the quest led him. If it led him into battle, as it was bound to do, so much the better. He was "ever a fighter." The love of Truth was his paramount passion, but he loved her all the more if he saw her life jeopardized and he could make a gallant charge for her rescue.

To have a mind eager to know the great truths and broad enough to take them in, and not get lost in the maze of apparent contradictions, is undoubtedly the highest good. This, I take it, is what our fathers meant in their way by saying the chief end of man was to serve God and glorify him forever. This formula is not suited to the temper of the modern scientific mind because of the theological savor that clings to it. Theological values have shrunk enormously in our time; but let the modern mind express the idea in its own terms, and it fully agrees. To love the Truth and possess it forever is the supreme good.

Of course Pilate's question of old comes up, What is truth? since one man's truth may be another man's falsehood. But not in the scientific realm, in the realm of verifiable objective truth. What is one man's truth here must be all men's truth. What is one man's truth in the business affairs of life — in trade, in banking, in mechanics, in agriculture, in law — must be all men's truth. It would seem as

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if what is one man's truth in so vital a matter as religion ought to be all men's truth. But it is not. Religion is such an intensely personal and subjective matter that no two men stand at just the same angle with reference to any one proposition, at least to the evidence of the truth of that proposition. The question of the soul's immortality seems such a vital question to some, while others are quite indifferent to it. One man says, I must have proof. I cannot rest in the idea that death ends all. Another says, What matters it? I am not sure I want endless existence. Ingersoll felt this way. Then if death does end all, we shall not lie in our graves lamenting our fate. If it does not, so much the better.

But is any form of religious belief such a vital matter after all? What noble and beautiful lives have been lived by people of just opposite religious creeds. A man's creed, in our day at least, seems to affect his life little more than the clothes he wears. The church has lost its power, its promises have lost their lure, its threats have lost their terror. It is a question why church attendance has so fallen off. In earlier times people attended church from a sense of duty; now the masses go only when there is a promise of pleasure, and that is less and less often.

Errors of religious belief are not serious. If they were, chaos would have come long ago. Each age repudiates or modifies the creed of the preceding,

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trims it or renews it as a man trims his orchard, lopping off the dead branches, or grafting new ones on, or resetting it entirely. All denominations are grafting on more liberal and more charitable views. The stock of religious ideas is undoubtedly improving — less personal, perhaps, but more broadly intellectual — generalizations from more universal facts.

In morality, what is one man's truth ought to be all men's truth, because morality is a matter of conduct toward our fellows. We may fail to keep our promises to our gods and nothing comes of it, but if we forget our promissory notes, something does come of it, and, as like as not, that something takes the form of the sheriff.

The scientific mind, like Huxley's, looks with amazement upon the credulity of the theological mind, upon its low standard of evidence.

There are currents and currents in life. A river is one kind of current, the Gulf Stream is another. The currents in the affairs of men are more like the latter — obscure in their origin, vague and shifting in their boundaries, and mysterious in their endings, and the result of large cosmic forces. There are movements in the history of men's minds that are local and temporary like that, say, of the Crusaders, or of Witchcraft, and there are others that are like ocean currents, a trend of the universal mind. The rise and growth of rationalism seems of this kind,

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the scientific spirit, the desire to prove all things, and to hold fast to that which is good. It is the conditions of proof that have become strenuous and exacting. The standard of the good has not gone up so much as the standard of evidence. We prove a thing now not by an appeal to a text of some book, or to any ecclesiastical court, but by an appeal to reason. An appeal to conscience is not conclusive, because conscience is more or less the creature of the hour, or of custom, or of training, but reason emancipates us from all false or secondary considerations, and enables us to see the thing as it is, in and of itself.

III

I have drifted into deeper waters than I intended to when I set out. I meant to have kept nearer the shore. I have had, I say, a happy life. When I was a young man (twenty-five), I wrote a little poem called "Waiting," which has had quite a history, and the burden of which is, "My own shall come to me." What my constitution demands, the friends, the helps, the fulfillments, the opportunities, I shall find somewhere, some time. It was a statement of the old doctrine of the elective affinities. Those who are born to strife and contention find strife and contention ready at their hand; those who are born for gentleness and love find gentleness and love drawn to them. The naturally suspicious and distrustful find the world in conspiracy against

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them; the unkind, the hard-hearted, see themselves in their fellows about them. The tone in which we speak to the world, the world speaks to us. Give your best and you will get the best in return. Give in heaping measure and in heaping measure it shall be returned. We all get our due sooner or later, in one form or another. "Be not weary in well doing;" the reward will surely come, if not in worldly goods, then in inward satisfaction, grace of spirit, peace of mind.

All the best things of my life have come to me unsought, but I hope not unearned. That would contradict the principle of equity I have been illustrating. A man does not, in the long run, get wages he has not earned. What I mean is that most of the good things of my life — friends, travel, opportunity — have been unexpected. I do not feel that fortune has driven sharp bargains with me. I am not a disappointed man. Blessed is he who expects little, but works as if he expected much. Sufficient unto the day is the *good* thereof. I have invested myself in the present moment, in the things near at hand, in the things that all may have on equal terms. If one sets one's heart on the exceptional, the far-off — on riches, on fame, on power — the chances are he will be disappointed; he will waste his time seeking a short cut to these things. There is no short cut. For anything worth having one must pay the price, and the price is always work,

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patience, love, self-sacrifice — no paper currency, no promises to pay, but the gold of real service.

I am not decrying ambition, the aiming high, only there is no use aiming unless you are loaded, and it is the loading, and the kind of material to be used, that one is first to be solicitous about.

“Serene I fold my hands and wait;” but if I have waited one day, I have hustled the next. If I have had faith that my own would come to me, I have tried to make sure that it was my own, and not that of another. Waiting with me has been mainly a cheerful acquiescence in the order of the universe as I found it — a faith in the essential veracity of things. I have waited for the sun to rise and for the seasons to come; I have waited for a chance to put in my oar. Which way do the currents of my being set? What do I love that is worthy and of good report? I will extend myself in this direction; I will annex this territory. I will not wait to see if this or that pays, if this or that notion draws the multitude. I will wait only till I can see my way clearly. In the meantime I will be clearing my eyes and training them to know the real values of life when they see them.

Waiting for some one else to do your work, for what you have not earned to come to you, is to murder time. Waiting for something to turn up is equally poor policy, unless you have already set the currents going that will cause a particular some-

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thing to turn up. The farmer waits for his harvest after he has sown the seed. The sailor waits for a breeze after he has spread his sail. Much of life is taken up in waiting — fruitful waiting.

I never have sought wealth, I have been too much absorbed in enjoying the world about me. I had no talent for business anyhow — for the cutthroat competition that modern business for the most part is — and probably could not have attained wealth had I desired it. I dare not aver that I had really rather be cheated than to cheat, but I am quite sure I could never knowingly overreach a man, and what chance of success could such a tenderfoot have in the conscienceless struggle for money that goes on in the business world? I am a fairly successful farmer and fruit-grower. I love the soil, I love to see the crops grow and mature, but the marketing of them, the turning of them into money, grinds my soul because of the sense of strife and competition that pervades the air of the market-place. If one could afford to give one's fruit away, after he had grown it to perfection, to people who would be sure to appreciate it, that would be worth while, and would leave no wounds. But that is what I have in a sense done with my intellectual products. I have not written one book for money (yes, one, and that was a failure); I have written them for love, and the modest sum they have brought me has left no sting.

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I look upon this craze for wealth that possesses nearly all classes in our time as one of the most lamentable spectacles the world has ever seen. The old prayer, "Give me neither poverty nor riches," is the only sane one. The grand mistake we make is in supposing that because a little money is a good thing, unlimited means is the sum of all good, or that our happiness will keep pace with the increase of our possessions. But such is not the case, because the number of things we can really make our own is limited. We cannot drink the ocean because we ever so thirsty. A cup of water from the spring is all we need. A friend of mine once said that if he outlived his wife, he should put upon her tombstone, "Died of Things" — killed by the multitude of her possessions. The number of people who are thus killed is no doubt very great. When Thoreau found that the specimens and curiosities that had accumulated upon his mantel-piece needed dusting, he pitched them out of the window.

The massing of a great fortune is a perilous enterprise. The giving away of a great fortune is equally a perilous enterprise, not to the man who gives it — it ought to be salutary to him — but to his beneficiaries.

Very many of the great fortunes of our time have been accumulated by a process like that of turning all the streams into your private reservoir: they have caused a great many people somewhere to be short

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of water, and have taken away the power of many busy, peaceful wheels. The ideal condition is an even distribution of wealth. When you try to give away your monstrous fortune, to open your dam, then danger begins, because you cannot return the waters to their natural channels. You must make new channels, and you may do more harm than good. It never can go now where it would have gone. The wealth is in a measure redistributed, without enriching those from whom it originally came. Few millionaires could face the questions: Have you rendered a service to your fellows in proportion to your wealth? Have you earned your fortune, or have you grabbed it? Is it an addition to the wealth of the world, or a subtraction from the wealth which others have earned? The wealth that comes to a man through his efforts in furthering the work of the world and promoting the good of all is the only worthy wealth.

Beyond the point of a moderate competency, wealth is a burden. A man may possess a competency; great wealth possesses him. He is the victim. It fills him with unrest; it destroys or perverts his natural relations to his fellows; it corrupts his simplicity; it thrusts the false values of life before him; it gives him power which it is dangerous to exercise; it leads to self-indulgence; it hardens the heart; it fosters a false pride. To give it away is perilous; to keep it is to invite care and vexation of

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spirit. For a rich man to lead the simple life is about as hard as for a camel to go through the needle's eye. How many things stand between him and the simple open air of our common humanity! Marcus Aurelius thought a man might be happy even in a palace; but it takes a Marcus Aurelius — a man whose simplicity of character is incorruptible — to be so. Yet I have no disposition to rail at wealth as such, though the penalties and dangers that attend it are very obvious. I never expect to see it go out of fashion. Its unequal distribution in all times, no doubt, results from natural causes.

Sooner or later things find their proper level, and the proper level of some things is on top. In the jostle and strife of this world the strong men, the master minds, are bound to be on top. This is inevitable; the very laws of matter are on their side.

Not socialism, or any other "ism," can permanently equalize the fortunes of men. The strong will dominate, the weak must succumb. "For whosoever hath, to him shall be given, and he shall have more abundance: but whosoever hath not, from him shall be taken away even that he hath." Power draws power; inefficiency loses even that which it hath. To abolish poverty, to abolish wealth, we must first abolish the natural inequality among mankind. It is as if some men had longer arms than others and could reach the fruit on the tree of opportunity beyond the grasp of their com-

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petitors. Shall we cut off their arms? No, we can only shame them out of making hogs of themselves and of laying up greater stores than they can possibly use. In our day and country, the golden fruit on the tree has been so abundant that the long-armed men have degenerated into wealth-maniacs, and have resorted to all manner of unfair means; they have trampled down the shorter-armed men, and gained an advantage on their prostrate bodies. That is where the injustice comes in. Some of our monstrous trusts and combines, for instance, have killed competition by foul and underhanded means; they have crowded or thrust their competitors entirely away from the tree, or else have mounted up on their shoulders. They have resorted to the methods of the robber and assassin.

I am bound to praise the simple life, because I have lived it and found it good. When I depart from it, evil results follow. I love a small house, plain clothes, simple living. Many persons know the luxury of a skin bath — a plunge in the pool or the wave unhampered by clothing. That is the simple life — direct and immediate contact with things, life with the false wrappings torn away — the fine house, the fine equipage, the expensive habits, all cut off. How free one feels, how good the elements taste, how close one gets to them, how they fit one's body and one's soul! To see the fire that

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warms you, or better yet, to cut the wood that feeds the fire that warms you; to see the spring where the water bubbles up that slakes your thirst, and to dip your pail into it; to see the beams that are the stay of your four walls, and the timbers that uphold the roof that shelters you; to be in direct and personal contact with the sources of your material life; to want no extras, no shields; to find the universal elements enough; to find the air and the water exhilarating; to be refreshed by a morning walk or an evening saunter; to find a quest of wild berries more satisfying than a gift of tropic fruit; to be thrilled by the stars at night; to be elated over a bird's nest, or over a wild flower in spring — these are some of the rewards of the simple life.

XIII

"ALL'S RIGHT WITH THE WORLD"

I

WHETHER or not we can accept Browning's morning line, "All's right with the world," depends upon our point of view. To the intellect, the disinterested faculties, undoubtedly, all's right with the world. To the seeing mind nature presents a series, an infinite series, of logical sequences; cause and effect are inseparably joined, and things could in no wise be other than what they are. The forces that destroy us are only going their appointed ways, and if they turned out or made an exception on our account, the very foundations of the universe would be impeached.

The creation is good, and man's explanation and vindication of it have given rise to what we call science. One recalls Whitman's lines:—

"I lie abstracted and hear beautiful tales of things and the reasons of things,
They are so beautiful I nudge myself to listen."

To our æsthetic faculties, all's right with the world. What beauty, what grandeur, what perfection! the sum of all we know or can know of

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these qualities. Sin, decay, ruin, death — all add to the picturesqueness of the world.

But to our moral sentiments, our sense of goodness, mercy, justice, benevolence, humility, self-denial — all those tender and restraining feelings that are called into action through our relations to our fellows, all is not right with the world. All, or nearly all, is wrong with the world. So much so that our fathers, to account for it, had to suppose some dire catastrophe had befallen creation and frustrated the original plan of the Creator. Hence the myth of Adam and Eve in the Garden, and the forbidden fruit that

“Brought death into the world and all our woe.”

The world is full of pain, suffering, cruelty, sin, defeat, injustice, hope deferred, calamities of fire, flood, storm, pestilence, wars, famine — young lives cut off in their bloom, old lives ending in sorrow and decrepitude, iniquity on the throne, virtue in the dust. How is love thwarted, how is pity shocked, how is our sense of mercy and of justice outraged, when we look out upon the world, past or present!

Tract after tract of history is knee-deep with blood, and mostly innocent blood. The cruelty of rulers, the blindness and infatuation of the people, the superstition of priests — waste, failures, anguish, treachery, greed everywhere — how the moral nature revolts at the spectacle of it all!

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Cardinal Newman drew back from the spectacle with the deepest distress. Not seeing God in the world, he said, was like looking into a mirror and not seeing his own face there. He could account for the fact only by inferring that the human race was implicated in some terrible aboriginal calamity. Had the cardinal looked creation over, he would have seen evidence of the same merciless strife, the same cruel struggle, and mystery, and failure everywhere.

This is the verdict of the moral sense, the cry of the wounded heart. It is not the vision of the intellect, it is the plaint of the benevolent emotions. In the face of it all the serene reason still sings, All's well with the world, all's well with man; still he mounts and mounts; "rise after rise bow the phantoms behind" him; sin and suffering are a condition of growth and development; the great laws are impersonal; the God of the intellect is without variableness or shadow of turning, he sends his rain upon the just and the unjust alike, and though he slay me, yet will I trust him; though a cry of pain and anguish ever goes up from the earth to a deaf heaven, the reason sees that life and the joy of life can be had on no other terms.

Newman found God only when he looked into his own conscience, into that artificial personality, as Huxley called it, which has been built up in each of us through ages of contact with our fellows,

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There he found the benevolence, the love, the sense of justice, which he failed to find in the world without. It is not a mere fling or witty retort that man creates God in his own image; it is profoundly true. And then he torments himself that he does not see this image reflected in nature. More and more, as his evolution goes on, he loves mercy, justice, goodness, and more and more he endows his gods with these attributes. In the long-past time, when those sentiments were far less developed in man, we find his gods much more cruel and wicked.

All moral and ethical sentiments and aspirations are purely personal, and relate to man in society. They are the fruit of the social aggregate. It may be said with a measure of truth that while man's intellect is from God, his moral nature is the work of his own hands. His reason is reflected in the course of nature; it is in unison with the cosmic process; it looks upon the world and says it is good; it is consistent and fulfills its own end. But his moral nature is not reflected in the objective world; there is hardly a trace of it there; there is only law which knows no mercy, or tenderness, or forgiveness, or self-sacrifice, and which is oblivious to pain and suffering. Hence the God which our moral nature demands is not found in the world; to the cosmic process he is a stranger; it rules him out as it rules out all our human weaknesses. Fly to the uttermost parts of the earth, and you will not find him there,

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or soar to the heavens or dive to the depths, and you will not find him there. Infinite and eternal power you find, but not the God of love and mercy that the moral nature craves. Only in the human heart do you find this God. Hence our fathers looked upon man as something entirely apart from nature; he was not the result of the cosmic process, but a special creation, endowed with special powers, and given an immortal soul, which was denied to all other creatures.

It is only by regarding man as a part of nature, as the outcome of the same vital forces underfoot and overhead that the plants and the animals are, that we can find God in the world.

When the intellect from its height of observation surveys man and the world, it sees that he is necessarily a part of nature, and that all he has done and thought and suffered, all his arts and religions and literatures, all his dreams and visions and aspirations, came out of the earth, were evolved through the working of natural or cosmic laws, because the reasoning mind cannot admit of the arbitrary introduction of any force or influence from without. The chain of cause and effect is never broken, and all the noble and godlike traits of man, all his love and heroism and self-denial, as well as all his baser animal traits—his hates, his revenges, his cruelty, his lusts, his meannesses of one kind or another—are not from some extraneous source, are not for-

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tuitous and unrelated, but have their root in the constitution of things. There is nothing on or in the earth that is not of the earth; it is all latent or patent in the cosmic process.

II

Strange how men have speculated about the origin of evil, and built themselves cages in which to bruise their own wings. Evil has been regarded as something as positive as light, or heat, or any tangible object. Our moral and religious nature has so regarded it, but the reason sees that evil is only the shadow of good, and is as inevitable as good is inevitable. Life has its positive and its negative sides. Its positive side is health and growth and enjoyment, its negative side is disease and decay and suffering. All that favors the former is good, all that leads to the latter is bad, relatively bad. Disease is only another form of life. The germs that are pulling us down and destroying us in typhoid fever or cholera are healthy and thriving if we are not. What is good for them is bad for us. Life preys upon life everywhere, and the devoured is the victim of evil. We live and move and have our being submerged in an ocean of germs, myriads of them for us and myriads of them against us on occasion; one kind building up, another kind pulling down, and, as it were, redistributing the type. Life as we know it could not go on without both

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kinds. Without the germs of fermentation, for instance, what would happen to the world? Without the germs that break down animal and vegetable tissue and redistribute the elements of which they are composed — the germs of death — how long could life go on?

A fever tortures and burns my flesh because the body fights against the germs that would destroy it. It is one form of life struggling with another form. A festering pool in the fields or woods conceals chemical processes that all favor life.

Life is the result of a certain balance between what we call good and evil forces. Destroy that balance, that harmonious adjustment, and death or disease follows. We imperil it when we eat too much, or drink too much, or work too hard, or sleep too little, or exclude the air and sunlight from our houses. A pestilence is just as much an evidence of the health and soundness of nature as is immunity from it, only it is the health of forces that for reasons antagonize our health. We have let the enemy encamp and intrench in our midst while we slumbered. If we had life on easier terms than eternal vigilance, what would it be worth? If we want to escape blow-flies and mosquitoes and the contagion of this or that, let us go to the Arctic or Antarctic regions, where death reigns perpetual.

Struggle is the condition of evolution, and evolution is the road all life has traveled. Moral evil

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pertains only to man, and is incident to his growth and development. To bear false witness against one's neighbor, or to steal, or to be cruel or covetous, are moral evils which we become conscious of only when we have reached a higher moral plane. The animal is not involved in such evils. Violence and fraud and injustice attest the existence of higher qualities. They are shadows and not real entities, the shortcomings of the unripe animal man. A foul day is just as much a legitimate part of our weather system as a fair day; and is it in itself any more evil?

What I mean to say is that the whole category of moral evils, from petty slander to gigantic stealing, from political corruption to social debauchery, are only eddies or back currents that attest the onward flow of moral progress. A parasite is an evil, but it could not exist without a host to prey upon.

Moral evil, like physical evil, is bestowed by the same hand that bestows the moral good; it is the fruit of the same tree — the wormy and scabby fruit — and while every effort is to be made to remedy it, we are not to regard it as something foreign to us, something the origin of which is involved in mystery, a subject for metaphysical or theological hair-splitting, and adequate to account for the strained relations, as our fathers viewed it, between God and man. Development implies imperfection; as long as our course is upward, we have

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not yet reached the top of the hill. Our standards rise as we rise, and the ideal always does and always will outrun the real. We may produce a perfect apple or a perfect peach, or plum, or pear, but not a perfect man, because to man are opened infinite possibilities. Perfect in honesty, in sobriety, in truthfulness, but not perfect in love, or sympathy, in self-denial, in veneration, or in wisdom. That good and evil are not such strangers is seen in the fact that present evil may turn out a future good, and *vice versa*. All the world looks upon poverty as an evil, yet of what men has it been the making! Reverses in business have often put a man upon a road that led to a higher success than was possible under the old conditions, a success which only verifies the soundness of the principles the disregarding of which led to the past failure. If gravity did not pull your faulty structure down, it would not enable your sound structure to stand up. If the rain did not come through your rotten roof, it would not percolate to the roots of the grass in the ground. Indeed, to abolish the possibility of evil from the universe would be to abolish the possibility of good. If vice and crime did not arise under certain conditions in society, all social progress would be barred. Out of the desire to better our condition comes the greed of wealth and the hoggishness of the millionaire. Out of sex love comes lust and fornication; out of the instinct of self-preservation comes base

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selfishness; the feeling of self-respect pushed a little too far becomes pride and vainglory; faith degenerates into credulity, worship into idolatry, deference into fawning, firmness into hardness of heart, self-reliance into arrogance. The danger that threatens repose is stagnation, that threatens industry is greed, that threatens thrift is avarice, that threatens power is tyranny. Everywhere are things linked together, every virtue has its vice, every good has its ill, every sweet has its bitter, and the bitter is often the best medicine.

What shall we say, then? Shall we be tolerant of evil? Shall we embrace vice as well as virtue? No; but we shall cease to try to persuade ourselves "that the celestial laws need to be worked over and rectified," that there is some ingrained defect in God's universe, and that the divine plan miscarried; that man in this world has got the bad end of a bad bargain. We get sooner or later what we pay for, and we do not get what we do not pay for, and there is no credit system.

"All's right with the world." I know it does not soothe the bruises of the victim of a railroad smash-up to be told that the laws of force could not act differently, nor the disappointment of the farmer when his crops are burned up by the drought to be assured that the weather system is still running all right elsewhere, nor the sick and the suffering to be told that pain too is a guardian angel; and yet it

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is something to know that things look better under the surface, that there is no profound conspiracy of evil against us, that the universe really has the well-being of each of us at heart, and that if we fall short of that well-being, we are not the victims of a malignant spirit, but the sufferers from the operation of a beneficent law.

The universe has our well-being at heart in a general, universal sense, and not in a personal sense. For instance, our lives depend upon the bounty of the rain, and yet the rain does not accommodate itself to the special personal needs of this man or that man, and it may result in a flood that brings death and ruin in its path. Like all other things in nature, it is a general beneficence to which we have to accommodate ourselves. It rains alike upon the just and the unjust, upon the sea and upon the land, upon the sown field and upon the mown hay — a broadcast, wholesale kind of providence.

I confess that from the course of life and the processes of nature one cannot infer the existence of a Being such as our fathers worshiped — a kind of omnipresent man, whose relation to the universe was that of maker and governor.

We get instead the conception of an infinite power, not separable from the universe, but one with it, as the soul is one with the body, which finally expresses itself in man as reason, as love, as awe, as beauty, as aspiration, as righteousness; in

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the brute world as instinct, cunning, ferocity, and other animal traits; in the material world as law, system, development, power. When we think of God in any kind of human relation to the universe, or as a being apart from it, as parent, judge, sovereign, guide, we at once stumble upon this problem of evil, and invent schemes to justify God's ways to man, to excuse or gloss over the cruelty, the suffering, the injustice, we see in the world; we invent the devil, the garden of Eden, the myth of the fall of man, sin, the atonement, the judgment day. These things flow naturally from our anthropomorphic conception of God. They help reconcile the irreconcilable; they bridge over the chasm. But to the naturalistic conception, as distinguished from the theological, these things are childish dreams, to be put from us as we put away other childish things. Sin has no more reality than the negative gravity that Frank Stockton imagined, redemption no more reality than the rebellion in heaven that Milton invented, and heaven and hell no more existence than any other fabled abode of the ancient world.

To science, every day is a judgment day, eternity is now and here, heaven lies all about us, all laws are celestial laws. God is literally in everything we see and hear and feel, in every flower that blows, and not a sparrow falls to the ground without his cognizance. Your days are appointed, and all the hairs of your head are numbered, because nothing

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goes by chance in this universe. Not a snowflake falls but its form and its course are determined by forces as old as the universe; pitch a stone from your hand and the elder gods know exactly where it shall alight. Is not this good predestinarianism? Yes, but not as Jonathan Edwards saw it; it is as science sees it. It is good everlastingism — the ways of a Power without variableness or shadow of turning, which Edwards anthropomorphized into a cruel, despotic, almighty man. We are predestined to heaven or hell by the dispositions we inherit from our fathers, by the environment which society makes for us, by the age and country in which we live, and by the strength and weakness of our own characters, which again are the result of forces as old as the race, and as constant and impersonal in their activity as gravitation.

The rising vapor proves gravitation as fully as the falling rain. The wildest, freest thing on wings goes only its appointed way. With the course of the swallow hawking for insects in the air, or with the course of the insects themselves soaring in the sunshine, the hand of chance plays no part any more than it does with the sailboat obeying wind and current on yonder bay, which again is a good symbol of a man's course throughout this world, impelled by impulses inherited from his fathers, and awakened by the circumstances of his life.

We speak of the chance meeting of this man and

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that woman which resulted in a union for life, and, so far as their conscious wills were concerned, the meeting was a matter of chance; but if we could see all the forces that have been at work to bring them together, we should discover that there was no more chance about it than about the conjunction of two planets in the evening sky.

Indeed, our lives are evidently the result of such a play and interplay of forces from far and from near, from the past and from the present, from the earth and from the heavens, forces so subtle and constant and so beyond the reach of our analysis, that one is half converted to the claims of astrology, and inclined to believe that the fate of each of us was written in the heavens before the foundations of the world.

III

Don't you suppose that if the trees in the forest, the grass in the field, the fruit in the orchard, could for a moment be conscious and speak, they would each and all say, There is evil here also, there is crime, there is sin, there is struggle, defeat, and death also? One plant could complain that there is another plant stealing from it, or trespassing upon its territory and robbing it; another is being crowded to the wall, another being dwarfed by its bigger and more sturdy neighbor. Cut down a tree in the forest, and in the spring a half dozen or more shoots start

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from the stump to replace the parent trunk. They all grow vigorously the first season; the whole push of the complex root system of the stump is behind them. They grow vigorously the second season, and the third, and maybe for several years more. But the competition becomes sharper and sharper; some of the shoots, from causes hard to penetrate, outstrip their fellows, they get the lead, they get more light, more foliage, and this enables them to take up more nourishment from the soil. The others lag, then stop, then die. Then the struggle among the three or four or five thrifty shoots goes on for a few years longer, till some of them are distanced, and finally die when they are the size of one's leg. Then two or three remain to take the place of the parent trunk. We witness here the same struggle that we witness in the animal world. It is all a question of the means of subsistence; the soil can nourish only just so much life, and the fittest or luckiest gets this nourishment, just the same as when you throw a bone to a pack of hungry dogs.

Sometimes the grain will "run out" the weeds, and sometimes the weeds will run out the grain, or the grass. The cereals that depend upon man, and that he depends upon, cannot of course hold their own with the wild denizens of the soil. Much care and culture has made them weak; they have grown dependent; they must be fed and cosseted and protected, the battle against the foes of life

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must be fought for them. All these cultivated plants are handicapped by a burden the wild things do not bear; the wild things are mainly bent only upon self-propagation: to this end their seeds are small and numerous; but the cultivated grains and vegetables bear a burden of food for man, aside from the germ necessary to their propagation. Wild rice is a lean, savage, hirsute product compared with the cultivated varieties; but the potato and the onion and the pippin—what a burden of starch and of other elements each bears, in contrast with the wild species!

Evil comes to the fruit tree in the orchard in the shape of frost that nips the fruit buds, or of worms that eat its foliage, or in the shape of birds that cut out the heart of the blossom, or in the shape of insects that lay their eggs in the baby fruit, or in the shape of fungus growths that fasten upon it and dwarf it or mar it. Evil threatens and sooner or later comes to everything that lives. Evil in this sense is a necessary part of the living universe; there is no escape from it. A world of competition, of diverse and opposed interests, is a world of struggle, of defeat, of death.

After the ice has been all nicely formed in the river, a miracle of crystallic beauty and perfection, the winds or the tides break it up and bring chaos to it. But the cold continues, the ice-packs freeze together, or new ice forms, the ruin of the first

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venture of the frost is a stepping-stone in the second; the river is again covered and may be again broken up, but by and by, under a still lower temperature, the thing is done and the river permanently frozen over. Then the struggle is between the frost and the sun till, in the spring, the latter wins.

IV

At least one thing is certain as the result of man's sojourn on this planet: he is becoming more and more at home on it, more and more on good terms with the nature around him. His childish fear and dread of it is largely gone. He now makes playfellows of things which once filled him with terror; he makes servants of forces that he once thought stood ready to devour him; he is in partnership with the sun and moon and all the hosts of heaven. He no longer peoples the air and the earth with evil spirits. The darkness of the night, or of caverns and forests, no longer conceals malignant powers or influences that are lying in wait to devour him. Even Milton speaks of

"this drear wood,
The nodding horror of whose shady brows
Threats the forlorn and wandering passenger."

To us the wood is filled with beauty and interest; the mountain is a challenge to climb to a vaster and higher outlook, and the abysmal seas hold records we would fain recover and peruse. Evil omens and

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prognostications have disappeared. Dread of Nature has been followed by curiosity about Nature, and curiosity has been followed by love. Men now love Nature as I fancy they have never loved her before. I fancy also that we have come to realize as never before the truth of the Creator's verdict upon his work: "And behold it was good."

To what do we owe this change? To the growth of the human reason led and fostered by science. Science has showed man that he is not an alien in the universe, that he is not an interloper, that he is not an exile from another sphere, or arbitrarily put here, but that he is the product of the forces that surround him. Science has banished the arbitrary, the miraculous, the exceptional, from nature, and instead of these things has revealed order, system, and the irrefragable logic of cause and effect. Instead of good and bad spirits contending with one another, it reveals an inevitable beneficence and a steady upward progress. It shows that the universe is made of one stuff, and that no atom can go amiss or lose its way.

When we look at man and his goings and comings at a far enough remove, I think we surely see that he is under laws and influences that he knows not of. In the Orient he shows one set of influences, in the Occident another. In the south he is of one temper, in the north of another. The stamp of his environment, of his climate, is upon him. Born in one age,

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he is seized with the spirit of adventure and plants colonies and kingdoms. Born in another, he rusts out at home. One age is of one complexion, another of another; one is an age of faith, the next an age of skepticism; the enthusiasm of one age is the joke of the next. We are puppets all, and obey unseen masters. The Time-spirit sets its seal upon us. The electric currents or the waves of vibration that cause the steel filings to spring into patterns are like the influences in an age that cause men to form parties and groups of one kind or another, swayed by a common impulse, the origin of which is in the will of none of them.

What, then, becomes of the freedom of the will of which we are all conscious? We do as we like. Yes, but what determines our liking? In this freedom fate is deftly concealed. Our choice is along the lines of forces or inborn tendencies of which we are unconscious. We are free to do as our inherited traits, our temperament, our environment, our training, the influence of the climate over us, and the geography and geology about us and beneath us decide. But these things are vital in us, and therefore we are unconscious of them. Hence our sense of free choice is not obstructed; we still do as we like, only something beyond our wills determines what we shall like.

The intellectual nature of man was developed long before his moral nature. His sense of beauty,

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of art, of ornament, is older than his sense of justice or mercy. Indeed, he was a religious being before he was a moral being. He worshiped and offered sacrifices before he dealt justly and humanely with his fellow.

Unless what we mean by good prevailed over the bad, we should not be here. If some sort of order and peace had not come out of the primal warring of the elements, man could not have appeared. The waters have been gathered together, the continents have been lifted up, the vapors have learned to form clouds, the soil has been formed, and the benediction of the flowers and of the grass is upon the hills. The destructive elemental forces have subsided. In nearly all parts of the earth man can subsist. The benevolence of Providence is seen in this general, inevitable course of nature. Right actions meet with their reward; health and wholeness are possible; deal fairly and squarely with Nature, and you always get the worth of your money. We know the conditions of disease; we know the conditions of health. The ways of the Eternal are appointed, and we may find them out.

Truly to obey the will of God is our salvation, but we must look for this will, not in some book or creed, but in the order of the universe, in the sequence of cause and effect.

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THE
COMPLETE NATURE WRITINGS
of
John Burroughs



TIME AND CHANGE

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PREFACE

I SUSPECT that in this volume my reader will feel that I have given him a stone when he asked for bread, and his feeling in this respect will need no apology. I fear there is more of the matter of hard science and of scientific speculation in this collection than of spiritual and æsthetic nutriment; but I do hope the volume is not entirely destitute of the latter. If I have not in some degree succeeded in transmuting my rocks into a kind of wholesome literary bread, or, to vary the figure, in turning them into a soil in which some green thing or flower of human interest and emotion may take root and grow, then, indeed, have I come short of the end I had in view.

I am well aware that my own interest in geology far outruns my knowledge, but if I can in some degree kindle that interest in my reader, I shall be putting him on the road to a fuller knowledge than I possess. As with other phases of nature, I have probably loved the rocks more than I have studied them. In my youth I delighted in lingering about and beneath the ledges of my native hills, partly in the spirit of adventure and a boy's love of the wild, and partly with an eye to their curious forms, and

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the evidences of immense time that looked out from their gray and crumbling fronts. I was in the presence of Geologic Time, and was impressed by the scarred and lichen-coated veteran without knowing who or what he was. But he put a spell upon me that has deepened as the years have passed, and now my boyhood ledges are more interesting to me than ever.

If one gains an interest in the history of the earth, he is quite sure to gain an interest in the history of the life on the earth. If the former illustrates the theory of development, so must the latter. The geologist is pretty sure to be an evolutionist. As science turns over the leaves of the great rocky volume, it sees the imprint of animals and plants upon them and it traces their changes and the appearance of new species from age to age. The biologic tree has grown and developed as the geologic soil in which it is rooted has deepened and ripened. I am sure I was an evolutionist in the abstract, or by the quality and complexion of my mind, before I read Darwin, but to become an evolutionist in the concrete, and accept the doctrine of the animal origin of man, has not for me been an easy matter.

The essays on the subject in this volume are the outcome of the stages of brooding and thinking which I have gone through in accepting this doctrine. I am aware that there is much repeti-

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tion in them, but maybe on that very account they will help my reader to go along with me over the long road we have to travel to reach this conclusion.

July, 1912.

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TIME AND CHANGE

I

THE LONG ROAD

I

THE long road I have in mind is the long road of evolution, — the road you and I have traveled in the guise of humbler organisms, from the first unicellular life in the old Cambrian seas to the complex and highly specialized creature that rules supreme in the animal kingdom to-day. Surely a long journey, stretching through immeasurable epochs of geologic time, and attended by vicissitudes of which we can form but feeble conceptions.

The majority of readers, I fancy, are not yet ready to admit that they, or any of their forebears, have ever made such a journey. We have all long been taught that our race was started upon its career only a few thousand years ago, started, not amid the war-rings of savage elemental nature, but in a pleasant garden with everything needed close at hand. This belief has faded a good deal in our time, especially among thoughtful persons; but in a modified form, as the special creation theory, it held sway in the minds of the older naturalists like Agassiz and Daw-

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son, long after Darwin had launched his revolutionary doctrine of our animal origin, putting man in the same zoölogical scheme as the lower orders.

We are slow to adjust our minds to the revelations of science, they have been so long adjusted to a revelation, so-called, of an entirely different character. It gives them a wrench more or less violent when we try to make them at home and at their ease amid these new and startling disclosures. To many good people evolution seems an ungodly doctrine, like setting up a remorseless logic in the place of an omnipresent Creator. But there is no help for it. Science has fairly turned us out of our comfortable little anthropomorphic notion of things into the great out-of-doors of the universe. We must and will get used to the chill, yea, to the cosmic chill, if need be. Our religious instincts will be all the hardier for it.

When we accepted Newton's discovery of the force called gravitation, we virtually surrendered ourselves to the enemy, and started upon a road, the road of natural causation, that traverses the whole system of created things. We cannot turn back; we may lie down by the roadside and dream our old dreams, but our children and their children will press on, and will be exhilarated by the journey.

It is at first sight an unpalatable truth that evolution confronts us with, and it requires courage calmly to face it. But it is in perfect keeping with the whole career of physical science, which is forever

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directing our attention to common near-at-hand facts for the key to remote and mysterious occurrences.

It seems to me that evolution adds greatly to the wonder of life, because it takes it out of the realm of the arbitrary, the exceptional, and links it to the sequence of natural causation. That man should have been brought into existence by the fiat of an omnipotent power is less an occasion for wonder than that he should have worked his way up from the lower non-human forms. That the manward impulse should never have been lost in all the appalling vicissitudes of geologic time, that it should have pushed steadily on, through mollusk and fish and amphibian and reptile, through swimming and creeping and climbing things, and that the forms that conveyed it should have escaped the devouring monsters of the earth, sea, and air till it came to its full estate in a human being, is the wonder of wonders.

In like manner, evolution raises immensely the value of the biological processes that are everywhere operative about us, by showing us that these processes are the channels through which the creative energy has worked, and is still working. Not in the far-off or in the exceptional does it seek the key to man's origin, but in the sleepless activity of the creative force, which has been pushing onward and upward, from the remotest time, till it has come to full fruition in man.

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It is easy to inject into man's natural history a supernatural element, as nearly all biologists and anthropologists before Darwin's time did, and as many serious people still do. It is too easy, in fact, and the temptation to do so is great. It makes short work of the problem of man's origin, and saves a deal of trouble. But this method is more and more discredited, and the younger biologists and natural philosophers accept the zoölogical conception of man, which links him with all the lower forms, and proceed to work from that.

When we have taken the first step in trying to solve the problem of man's origin, where can we stop? Can we find any point in his history where we can say, Here his natural history ends, and his supernatural history begins? Does his natural history end with the pre-glacial man, with the cave man, or the river-drift man, with the low-browed, long-jawed fossil man of Java, — *Pithecanthropus erectus*, described by Du Bois? Where shall we stop on his trail? I had almost said "step on his tail," for we undoubtedly, if we go back far enough, come to a time when man had a tail. Every unborn child at a certain stage of its development still has a tail, as it also has a coat of hair and a hand-like foot. But could we stop with the tailed man — the manlike ape, or the apelike man? Did his Creator start him with this appendage, or was it a later suffix of his own invention?

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If we once seriously undertake to solve the riddle of man's origin, and go back along the line of his descent, I doubt if we can find the point, or the form, where the natural is supplanted by the supernatural as it is called, where causation ends and miracle begins. Even the first dawn of protozoic life in the primordial seas must have been natural, or it would not have occurred, — must have been potential in what went before it. In this universe, so far as we know it, one thing springs from another; the sequence of cause and effect is continuous and inviolable.

We know that no man is born of full stature, with his hat and boots on; we know that he grows from an infant, and we know the infant grows from a foetus, and that the foetus grows from a bit of nucleated protoplasm in the mother's womb. Why may not the race of man grow from a like simple beginning? It seems to be the order of nature; it *is* the order of nature, — first the germ, the inception, then the slow growth from the simple to the complex. It is the order of our own thoughts, our own arts, our own civilization, our own language.

In our candid moments we acknowledge the animal in ourselves and in our neighbors, — especially in our neighbors, — the beast, the shark, the hog, the sloth, the fox, the monkey; but to accept the notion of our animal origin, that gives us pause. To believe that our remote ancestor, no matter how remote in time or space, was a lowly organized crea-

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ture living in the primordial seas with no more brains than a shovel-nosed shark or a gar-pike, puts our scientific faith to severe test.

Think of it. For countless ages, millions upon millions of years, we see the earth swarming with life, low bestial life, devouring and devoured, myriads of forms, all in bondage to nature or natural forces, living only to eat and to breed, localized, dependent upon place and clime, shaped to specific ends like machines, — to fly, to swim, to climb, to run, to dig, to drill, to weave, to wade, to graze, to crush, — knowing not what they do, as void of conscious purpose as the thorns, the stings, the hooks, the coils, and the wings in the vegetable world, making no impression upon the face of nature, as much a part of it as the trees and the stones, species after species having its day, and then passing off the stage, when suddenly, in the day before yesterday in the geologic year, so suddenly as to give some color of truth to the special creation theory, a new and strange animal appears, with new and strange powers, separated from the others by what appears an impassable gulf, less specialized in his bodily powers than the others, but vastly more specialized in his brain and mental powers, instituting a new order of things upon the earth, the face of which he in time changes through his new gift of reason, inventing tools and weapons and language, harnessing the physical forces to his own ends, and putting all

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things under his feet, — man the wonder-worker, the beholder of the stars, the critic and spectator of creation itself, the thinker of the thoughts of God, the worshiper, the devotee, the hero, spreading rapidly over the earth, and developing with prodigious strides when once fairly launched upon his career. Can it be possible, we ask, that this god was fathered by the low bestial orders below him, — instinct giving birth to reason, animal ferocity developing into human benevolence, the slums of nature sending forth the ruler of the earth. It is a hard proposition, I say, undoubtedly the hardest that science has ever confronted us with.

Haeckel, discussing this subject, suggests that it is the parvenu in us that is reluctant to own our lowly progenitors, the pride of family and position, like that of would-be aristocratic sons who conceal the humble origin of their parents. But it is more than that; it is the old difficulty of walking by faith where there is nothing visible to walk upon: we lack faith in the efficiency of the biologic laws, or any mundane forces, to bridge the tremendous chasm that separates man from even the highest of the lower orders. His radical unlikeness to all the forms below him, as if he moved in a world apart, into which they could never enter, as in a sense he does, is where the difficulty lies. Moreover, evolution balks us because of the inconceivable stretch of time during which it has been at work. It is as impossible for

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us to grasp geological time as sidereal space. All the standards of measurement furnished us by experience are as inadequate as is a child's cup to measure the ocean.

Several million years, or one million years, — how can we take it in? We cannot. A hundred years is a long time in human history, and how we pause before a thousand! Then think of ten thousand, of fifty thousand, of one hundred thousand, of ten hundred thousand, or one million, or of one hundred million! What might not the slow but ceaseless creative energy do in that time, changing but a hair in each generation! If our millionaires had to earn their wealth cent by cent, and carry each cent home with them at night, it would be some years before they became millionaires. This is but a faint symbol of the slow process by which nature has piled up her riches. She has had no visions of sudden wealth. To clothe the earth with soil made from the disintegrated mountains — can we figure that time to ourselves? The Orientals try to get a hint of eternity by saying that when the Himalayas have been ground to powder by allowing a gauze veil to float against them once in a thousand years, eternity will only have just begun. Our mountains have been pulverized by a process almost as slow. In our case the gauze veil is the air, and the rains, and the snows, before which even granite crumbles. See what the god of erosion, in the shape of water, has done in the

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river valleys and gorges — cut a mile deep in the Colorado canyon, and yet this canyon is but of yesterday in geologic time. Only give the evolutionary god time enough and all these miracles are surely wrought.

Truly it is hard for us to realize what a part time has played in the earth's history, — just time, duration, — so slowly, oh, so slowly, have the great changes been brought about! The turning of mud and silt into rock in the bottom of the old seas seems to have been merely a question of time. Mud does not become rock in man's time, nor vegetable matter become coal. These processes are too slow for us. The flexing and folding of the rocky strata, miles deep, under an even pressure, is only a question of time. Allow time enough and force enough, and a layer of granite may be bent like a bow. The crystals of the rock seem to adjust themselves to the strain, and to take up new positions, just as they do, much more rapidly, in a cake of ice under pressure. Probably no human agency could flex a stratum of rock, because there is not time enough, even if there were power enough. "A low temperature acting gradually," says my geology, "during an indefinite age would produce results that could not be otherwise brought about even through greater heat." "Give us time," say the great mechanical forces, "and we will show you the immobile rocks and your rigid mountain chains as flexible as a piece of

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leather." "Give us time," say the dews and the rains and the snowflakes, "and we will make you a garden out of those same stubborn rocks and frowning ledges." "Give us time," says Life, starting with her protozoans in the old Cambrian seas, "and I will not stop till I have peopled the earth with myriad forms and crowned them all with man."

Dana thinks that had "a man been living during the changes that produced the coal, he would not have suspected their progress," so slow and quiet were they. It is probable that parts of our own sea-coast are sinking and other parts rising as rapidly as the oscillation of the land and sea went on that resulted in the laying down of the coal measures.

An eternity to man is but a day in the cosmic process. In the face of geologic time, man's appearance upon the earth as man, with a written history, is something that has just happened; it was in this morning's paper, we read of it at breakfast. As evolution goes, it will not be old news yet for a hundred thousand years or so, and by that time, what will he have done, if he goes on at his present rate of accelerated speed? Probably he will not have caught the gods of evolution at their work, or witnessed the origin of species by natural descent, these things are too slow for him; but he will certainly have found out many things that we are all eager to know.

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In nature as a whole we see results and not processes. We see the rock strata bent and folded, we see the whole mountain-chains flexed and shortened by the flexure; but had we been present, we should not have suspected what was going on. Our little span of life does not give us the parallax necessary. The rock strata, miles thick, may be being flexed now under our feet, and we know it not. The earth is shrinking, but so slowly! When, under the slow strain, the strata suddenly give way or sink, and an earthquake results, then we know something has happened.

A recent biologist and physicist thinks, and doubtless thinks wisely, that the reason why we have never been able to produce living from non-living matter in our laboratories, is that we cannot take time enough. Even if we could bring about the conditions of the early geologic ages in which life had its dawn, which of course we cannot, we could not produce life because we have not geologic time at our disposal.

The reaction which we call life was probably as much a cosmic or geologic event as were the reactions which produced the different elements and compounds, and demanded the same slow gestation in the womb of time. During what cycles upon cycles the great mother-forces of the universe must have brooded over the inorganic before the organic was brought forth! The archæan age, during which the

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brooding seems to have gone on, was probably as long as all the ages since.

How we are baffled when we talk about the beginning of anything in nature or in our own lives! In our experience there must be a first, but when did manhood begin; when did puberty, when did old age, begin? When did each stage of our mental growth begin? When or where did the English language begin, or the French, or the German? Was there a first English word spoken? From the first animal sound, if we can conceive of such, up to the human speech of to-day, there is an infinite gradation of sounds and words.

Was there a first summer, a first winter, a first spring? There could hardly have been a first day even for ages and ages, but only slowly approximating day. After an immense lapse of time the air must have cleared and the day become separated from the night, and the seasons must have become gradually defined. Things slowly emerge one after another from a dim, nebulous condition, both in our own growth and experience and in the development of the physical universe.

In nature there is no first and last. There is an endless beginning and an endless ending. There was no first man or first woman, no first bird, or fish, or reptile. Back of each one stretches an endless chain of approximating men and birds and reptiles.

This talk about the time and place where man

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began his existence seems to me misleading, because it appears to convey the idea that he began as man at some time, in some place. Whereas he grew. He began where and when the first cell appeared, and he has been on the road ever since. There is no point in the line where he emerged from the not-man and became man. He was emerging from the not-man for millions of years, and when you put your finger on an animal form and say, This is man, you must go back through whole geologic periods before you reach the not-man. If Darwin is right, there is no more reason for believing that the different species or forms of animal life were suddenly introduced than there is for believing that the soil, or the minerals, gold, silver, diamonds, or vegetable mold and verdure were suddenly introduced.

II

If we know anything of the earth's past history, we know that the continents were long in forming, that they passed through many vicissitudes of heat and cold, of fire and flood, of upheaval and subsidence — that they had, so to speak, their first low, simple rudimentary or invertebrate life, that they were all slow in getting their backbones, slower still in clothing their rock ribs with soil and verdure, that they passed through a sort of amphibian stage, now under water, now on dry land, that their many kinds of soils and climes were not differ-

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entiated and their complex water-systems established till well into Tertiary times — in short, that they have passed more and more from the simple to the complex, from the disorganized to the organized. When man comes to draw his sustenance from their breasts, may they not be said to have reached the mammalian stage?

The fertile plain and valley and the rounded hill are of slow growth, immensely slow. But any given stage of the earth has followed naturally from the previous stage, only more and more and higher and higher forces took a hand in the game. First its elements passed through the stage of fire, then through the stage of water, then merged into the stage of air. More and more the aerial elements — oxygen, carbon, nitrogen — have entered into its constituents and fattened the soil. The humanizing of the earth has been largely a process of oxidation. More than disintegrated rock makes up the soil; the air and the rains and the snows have all contributed a share.

The history of the soil which we turn with our spade, and stamp with our shoes, covers millions upon millions of years. It is the ashes of the mountains, the leavings of untold generations of animal and vegetable life. It came out of the sea, it drifted from the heavens; it flowed out from the fiery heart of the globe; it has been worked over and over by frost and flood, blown by winds, shoveled by ice, — mixed and kneaded and moulded as the house-

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wife kneads and moulds her bread, — refining and refining from age to age. Much of it was held in solution in the primordial seas, whence it was filtered and used and precipitated by countless forms of marine life, making a sediment that in time became rocks, that again in time became continents or parts of them, which the aerial forces reduced to soil. Indeed, the soil itself is an evolution, as much so as the life upon it.

We probably have little conception of how intimate and coöperative all parts of the universe are with one another, — of the debt we owe to the farthest stars, and to the remotest period of time. We must owe a debt to the monsters of Mesozoic and Cænozoic time; they helped to fertilize the soil for us, and to discipline the ruder forces of life. We owe a debt to all that has gone before: to the heavens above and to the earth-fires beneath, to the ice-sheets that ground down the mountains, and to the ocean currents. Just as we owe a debt to the men and women in our line of descent, so we owe a debt to the ruder primordial forces that shaped the planet to our use, and took a hand in the game of animal life.

The gods of evolution had served a long apprenticeship; they had gained proficiency and were master workmen. Or shall we say that the elements of life had become more plastic and adaptable, or that the life fund had accumulated, so to speak? Had the vast succession of living beings, the long ex-

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perience in organization, at last made the problem of the origin of man easier to solve?

One fancies every living thing as not only returning its mineral elements to the soil, but as in some subtle way leaving its vital forces also, and thus contributing to the impalpable, invisible storehouse of vital energy of the globe.

At first among the mammalian tribes there was much muscle and little brains. But in the middle Tertiary the mammal brain began suddenly to enlarge, so that in our time the brain of the horse is more than eight times the size of the brain of his progenitor, the *dinoceras* of Eocene times.

Nature seems to have experimented with brains and nerve ganglia, as she has with so many other things. The huge reptilian creatures of Mesozoic time — the various dinosaurs — had ridiculously small heads and brains, but they had what might be called supplementary brains well toward the other end of the body, — great nervous masses near the sacrum, many times the size of the ostensible brain, which no doubt performed certain brain functions. But the principle of centralization was at work, and when in later time we reach the higher mammalian forms, we find these outlying nervous masses called in, so to speak, and concentrated in the head.

Nature has tried the big, the gigantic, over and over, and then abandoned it. In Carboniferous

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times there was a gigantic dragon-fly, measuring more than two feet in the expanse of wings. Still earlier, there were gigantic mollusks and sea scorpions, a cephalopod larger than a man; then gigantic fishes and amphibians and reptiles, followed by enormous mammals. But the geologic record shows that these huge forms did not continue. The mollusks that last unchanged through millions of years are the clam and the oyster of our day. The huge mosses and tree-ferns are gone, and only their humbler types remain. Among men giants are short-lived.

On the other hand, the steady increase in size of certain other species of animals during the later geologic ages is a curious and interesting fact. The first progenitors of the elephant that have been found show a small animal that steadily grew through the ages till the animal as we now find it is reached. Among the invertebrates this same progressive increase in size has been noted, a small shell in the Devonian becoming enormous in the Triassic. Certain species of sharks of medium size in the lower Eocene continue to increase till they attain the astounding dimensions in the Miocene and Pliocene of over one hundred feet long. A certain fish appearing in the Devonian as a small fish of seven centimetres in length, becomes in the Carboniferous era a creature twenty-seven centimetres in length. Among the mammals of Tertiary times this same

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law of steady increase in size has been operative, as seen in the *Felidæ*, the stag, and the antelope. Man himself has, no doubt, been under the same law, and is probably a much larger animal than any of his Tertiary ancestors. In the vegetable world this process, in many cases, at least, has been reversed, and the huge treelike club-mosses and horse-tails of Carboniferous times have dwindled in our time to very insignificant herbaceous forms.

Animals of overweening size are handicapped in many ways, so that nature in most cases finally abandons the gigantic and sticks to the medium and the small.

III

Can we fail to see the significance of the order in which life has appeared upon the globe — the ascending series from the simple to the more and more complex? Can we doubt that each series is the outcome of the one below it — that there is a logical sequence from the protozoa up through the invertebrates, the vertebrates, to man? Is it not like all that we know of the method of nature? Could we substitute the life of one period for that of another without doing obvious violence to the logic of nature? Is there no fundamental reason for the gradation we behold?

All animal life lowest in organization is earliest in time, and *vice versa*, the different classes of a sub-kingdom, and the different orders of a class, suc-

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ceeding one another, as Cope says, in the relative order of their zoölogical rank. Thus the sponges are later than the protozoa, the corals succeed the sponges, the sea-urchins come after the corals, the shell-fish follow the sea-urchins, the articulates are later than the shell-fish, the vertebrates are later than the articulates. Among the former, the amphibian follows the fish, the reptile follows the amphibian, the mammal follows the reptile, and non-placental mammals are followed by the placental.

It almost seems as if nature hesitated whether to produce the mammal from the reptile or from the amphibian, as the mammal bears marks of both in its anatomy, and which was the parent stem is still a question.

The heart started as a simple tube in the *Leptocardii*; it divides itself into two cavities in the fishes, into three in the reptiles, and into four in the birds and mammals. So the ossification of the vertebral column takes place progressively, from the Silurian to the middle Jurassic.

The same ascending series of creation as a whole is repeated in the inception and development of every one of the higher animals to-day. Each one begins as a single cell, which soon becomes a congeries of cells, which is followed by congeries of congeries of cells, till the highly complex structure of the grown animal with all its intricate physiological activities and specialization of parts, is reached. It

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is typical of the course of the creative energy from the first unicellular life up to man, each succeeding stage flowing out of, and necessitated by, the preceding stage.

How slowly and surely the circulatory system improved! From the cold-blooded animal to the warm-blooded is a great advance. In the warm-blooded is developed the capacity to maintain a fixed temperature while that of the surrounding medium changes. The brain and nervous system display the same progressive ascent from the brainless acrania, up through the fishes, batrachia, reptiles, and birds to the top in mammals. The same with the skeletons in the invertebrates, from membrane to cartilage, from cartilage to bone, so that the primitive cartilage remaining in any part of the skeleton is considered a mark of inferiority.

According to Cope, there has been progressive improvement in the mechanism of the body—it has become a better and better machine. The suspension of the lower jaw, so as to bring the teeth nearer the power, — the masseter and related muscles, — was a slow evolution and a great advance. The fin is more primitive than the limb; the limbs themselves display a constantly increasing differentiation of parts from the batrachian to the mammalian. There was no good ankle joint in early Eocene times. The model ankle joint is a tongue and groove arrangement, and this is a later evolution. In Eo-

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cene times they were nearly all flat. The arched foot, too, comes in; this is an advance on the flat foot. The bones of the palms and soles are not locked until the later Tertiary. The vertebral column progressed in the same way, from flat to the double curve and the interlocking process, thus securing greatest strength with greatest mobility. In the earliest life locomotion was diffused, later it became concentrated. The worm walks with its whole body.

IV

If we figure to ourselves the geologic history of the earth under the symbol of a year of three hundred and sixty-five days, each day a million years, which is probably not far out of the way, then man, the biped, the *Homo sapiens*, in relation to this immense past, is of to-day, or of this very morning; while the origin of the first vertebrates, the fishes, from which he has arisen, falls nearer the middle of the great year. Or, dividing this geologic year into four divisions or seasons, primary, secondary, tertiary, and quaternary, the fishes fall in the primary, the reptiles in the secondary, the mammals in the tertiary, and man in the early quaternary.

If the fluid earth hardened, and the seas were formed in the first month of this year, then probably the first beginning of life appeared in the second month, the invertebrate in the third or fourth, — March or April, — the vertebrates in May or June,

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the amphibians in July or August, the reptiles in August or September, the mammals in October or November, and man in December, — separated from the first beginnings of life by all those millions upon millions of years.

If life is a ferment, as we are told it is, how long it took this yeast to leaven the whole loaf! Man is evidently the end of the series, he is the top of the biological tree. His specialization upon physical lines seems to have ended far back in geologic time; his future specialization and development is evidently to be upon mental and spiritual lines. Nature, as I have said, began to tend more and more to brains in the early Tertiary, — the autumn of the great year; her best harvest began to mature then, her grain began to ripen. Indeed, this increased cephalization of animal life in the fall of the great year does suggest a kind of ripening process, the turning of the sap and milk, which had been so abundant and so riotous in the earlier period, into fibre and fruit and seed.

May it not be that that long and sultry spring and summer of the earth's early history, a time probably longer than has since elapsed, played a part in the development of life analogous to that played by our spring and summer, making it opulent, varied, gigantic, and making possible the condensation and refinement that came with man in the recent period?

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The earth is a pretty big apple, and the solar tree upon which it hangs is a pretty big tree, but why may it not have gone through a kind of ripening process for all that? its elements becoming less crude and acrid, and better suited to sustain the higher forms, as the eons passed?

At any rate, the results seem to justify such a fancy. The earth has slowly undergone a change that may fairly be called a ripening process; its soil has deepened and mellowed, its harsher features have softened, more and more color has come to its surface, the flowers have bloomed, the more succulent fruits have developed, the air has cleared, and love and benevolence and altruism have been born in the world.

V

Life had to creep or swim long before it could walk, and it walked long before it could fly; it had feeling long before it had eyes, and it no doubt had eyes long before it could hear or smell. It was capable of motion long before it had limbs; it assimilated food long before it had a mouth or a stomach. It had a digestive tract long before it had a spinal cord; it had nerve ganglia long before it had a well-defined brain. It had sensation long before it had perception; it was unisexual long before it was bisexual; it had a shell long before it had a skeleton; it had instinct and reflex action long before it had self-consciousness and reason. Always from the

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lower to the higher, from the simple to the more complex, and always slowly, gently.

Life has had its foetal stage, its stage of infancy, and childhood, and maturity, and will doubtless have its old age. It took it millions upon millions of years to get out of the sea upon dry land; and it took it more millions upon dry land, or since the Carboniferous age, when the air probably first began to be breathable, — all the vast stretch of the Secondary and Tertiary ages, — to get upright and develop a reasoning brain, and reach the estate of man. Step by step, in orderly succession, does creation move. In the rising and in the setting of the sun one may see how nature's great processes steal upon us, silently and unnoticed, yet always in sequence, stage succeeding stage, one thing following from another, the spectacular moment of sunset following inevitably from the quiet, unnoticed sinking of the sun in the west, or the startling flash of his rim above the eastern horizon only the fulfillment of the promise of the dawn. All is development and succession, and man is but the sunrise of the dawn of life in Cambrian or Silurian times, and is linked to that time as one hour of the day is linked to another.

The more complex life became, the more rapidly it seems to have developed; till it finally makes rapid strides to reach man. One seems to see Life, like a traveler on the road, going faster and faster as it nears its goal. Those long ages of unicellular

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life in the old seas, how immense they appear to have been; then how the age of invertebrates dragged on, millions upon millions of years; then the age of fishes; the Palæozoic age, how vast — put by Haeckel at thirty-four millions of years, adding rock strata forty-one thousand feet thick; then the Mesozoic or third period, the age of reptiles, eleven million years, with strata twelve thousand feet thick. Then came the Cænozoic age, or age of mammals, three million years, with strata thirty-one hundred feet thick. The god of life was getting in a hurry now; man was not far off. A new device, the placenta, was hit upon in this age, and probably the diaphragm and the brain of animals, all greatly enlarged. Finally comes the Anthropozoic or Quaternary age, the age of man, three hundred thousand years, with not much addition to the sedimentary rocks.

Man seems to be the net result of it all, of all these vast cycles of Palæozoic, Mesozoic, and Cænozoic life. He is the one drop finally distilled from the vast weltering sea of lower organic forms. It looks as if it all had to be before he could be — all the delay and waste and struggle and pain — all that long carnival of sea life, all that saturnalia of gigantic forms upon the land and in the air, all that rising and sinking of the continents, and all that shoveling to and fro and mixing of the soils, before the world was ready for him.

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In the early Tertiary, millions of years ago, the earth seems to have been ripe for man. The fruits and vegetables and the forest trees were much as we know them, the animals that have been most serviceable to us were here, spring and summer and fall and winter came and went, evidently birds sang, insects hummed, flowers bloomed, fruits and grains and nuts ripened, and yet man as man was not.

Under the city of London is a vast deposit of clay in which thousands of specimens of fossil fruit have been found like our date, cocoanut, areca, custard-apple, gourd, melon, coffee, bean, pepper, and cotton plant, but no sign of man. Why was his development so tardy? What animal profited by this rich vegetable life? The hope and promise of the human species at that time probably slept in some lowly marsupial. Man has gathered up into himself, as he traveled his devious way, all the best powers of the animal kingdom he has passed through. His brain supplies him with all that his body lacks, and more. His specialization is in this highly developed organ. It is this that separates him so widely from all other animals.

Man has no wings, and yet he can soar above the clouds; he is not swift of foot, and yet he can outspeed the fleetest hound or horse; he has but feeble weapons in his organization, and yet he can slay or master all the great beasts; his eye is not so sharp as that of the eagle or the vulture, and yet he can see

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into the farthest depths of siderial space; he has only very feeble occult powers of communication with his fellows, and yet he can talk around the world and send his voice across mountains and deserts; his hands are weak things beside a lion's paw or an elephant's trunk, and yet he can move mountains and stay rivers and set bounds to the wildest seas. His dog can out-smell him and out-run him and out-bite him, and yet his dog looks up to him as to a god. He has erring reason in place of unerring instinct, and yet he has changed the face of the planet.

Without the specialization of the lower animals, — their wonderful adaptation to particular ends, — their tools, their weapons, their strength, their speed, man yet makes them all his servants. His brain is more than a match for all the special advantages nature has given them. The one gift of reason makes him supreme in the world.

VI

We have a stake in all the past life of the globe. It is no doubt a scientific fact that your existence and mine were involved in the first cell that appeared, that the first zoöphyte furthered our fortunes, that the first worm gave us a lift. Great good luck came to us when the first pair of eyes were invented, probably by the trilobite back in Silurian times; when the first ear appeared, probably in

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Carboniferous times; when the first pair of lungs grew out of a fish's air-bladder, probably in Triassic times; when the first four-chambered heart was developed and double circulation established, probably with the first warm-blooded animal in Mesozoic times.

These humble forms started the brain, the nervous system, the circulation, sight, hearing, smell; they invented the liver, the kidneys, the lungs, the heart, the stomach, and led the way to every organ and power my body and mind have to-day. They were the pioneers, they were the dim remote forebears, they conserved and augmented the fund of life and passed it along.

All their struggles, their discipline, their battles, their failures, their successes, were for you and me. Man has had the experience of all the animals below him. He has suffered and struggled as a fish, he has groveled and devoured as a reptile, he has fought and triumphed as a quadruped, he has lived in trees as a monkey, he has inhabited caves with the wolf and the bear, he has roamed the forests and plains as a savage, he has survived without fire or clothes or weapons or tools, he has lived with the mastodon and all the saurian monsters, he has held his own against great odds, he has survived the long battles of the land and the sea, he weathered the ice-sheet that overrode both hemispheres, he has seen many forms become extinct. In the historic

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period he has survived plague and pestilence, and want and famine. What must he have survived in prehistoric times! What must he have had to contend with as a cave-dweller, as a tree-dweller, as a river-drift man! Before he had tools or weapons what must he have had to contend with!

Nature was full of sap and rioted in rude strength well up to Quaternary times, producing extravagant forms which apparently she had no use for, as she has discontinued them.

In all these things you and I had our part and lot; of this prodigal outpouring of life we have reaped the benefit; amid these bizarre forms and this carnival of lust and power, the manward impulse was nourished and forwarded. In Eocene times nearly half the mammals lived on other animals; it must have been an age of great slaughter. It favored the development of fleetness and cunning, in which we too have an interest. Our rude progenitor was surely there in some form, and escaped the slaughter. Then or later it is thought he took to the trees to escape his enemies, as the rats in Jamaica have taken to the trees to escape the mongoose. To his tree-climbing we probably owe our hand, with its opposing thumb.

In all his disguises he is still our ancestor. His story reads like a fairy book. Never did nimble fancy of childhood invent such transformations — only the transformations are so infinitely slow, and attended with such struggle and suffering. Strike

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out the element of time and we have before us a spectacle more novel and startling than any hocus-pocus or legerdemain that ever set the crowd agape.

In every form man has passed through, he left behind some old member or power and took on some new. He left his air-bladder and his gills and his fins with the fishes; he got his lungs from the dipnoans, the precursors of the amphibians, and from these last he got his four limbs; he left some part of his anatomy with the reptile, and took something in exchange, probably his flexible neck. Somewhere along his line he picked up the four-chambered heart, the warm blood, the placenta, the diaphragm, the plantigrade foot, the mammary glands — indeed, what has he not picked up on the long road of his many transformations? He left some of his superfluous forty-four teeth with his ancestral quadrumana of Eocene times, and kept thirty-two. He picked up his brain somewhere on the road, probably far back in Palæozoic times, but how has he developed and enlarged it, till it is now the one supreme thing in the world! His fear, his cunning, his anger, his treachery, his hoggishness — all his animal passions — he brought with him from his animal ancestors; but his moral and spiritual nature, his altruism, his veneration, his religious emotions, his æsthetic perceptions — have come to him as a man, supplementing his lower nature, as it were,

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with another order of senses — a finer sight, a finer touch, wrought in him by the discipline of life, and the wonder of the world about him, beginning *de novo* in him only as the wing began *de novo* in the bird, or the color began *de novo* in the flower — struck out from preëxisting potentialities. The father of the eye is the light, and the father of the ear is the vibration of the air, but the father of man's higher nature is a question of quite another sort. About the only thing in his physical make-up that man can call his own is his chin. None of the orders below him seem to have what can strictly be called a chin.

Man owes his five toes and five fingers to the early amphibians of the sub-carboniferous times. The first tangible evidence of these five toes upon the earth is, to me, very interesting. The earliest record of them that I have heard of is furnished by a slab of shale from Pennsylvania, upon which, while it was yet soft mud, our first five-toed ancestor had left the imprint of his four feet. He was evidently a small, short-legged gentleman with a stride of only about thirteen inches, and he carried a tail instead of a cane. He was probably taking a stroll upon the shores of that vast Mediterranean Sea that occupied all the interior of the continent when he crossed his mud flat. It was raining that morning — how many million years ago? — as we know from the imprint of the raindrops upon the mud. Probably

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the shower did not cause him to quicken his pace, as amphibians rather like the rain. Just what his immediate forbears were like, or what the forms were that connected him with the fishes, we shall probably never know. Doubtless the great book of the rocky strata somewhere holds the secret, if we are ever lucky enough to open it at the right place. How many other secrets, that evolutionists would like to know, those torn and crumpled leaves hold!

It is something to me to know that it rained that day when our amphibian ancestor ventured out. The weather was beginning to get organized also, and settling down to business. It had got beyond the state of perpetual mist and fog of the earlier ages, and the raindrops were playing their parts. Yet, from all the evidence we have, we infer that the climate was warm and very humid, like that of a greenhouse, and that vegetation, mostly giant ferns and rushes and lycopods, was very rank, but there was no grass, or moss, no deciduous trees, or flowers, or fruit, as we know these things.

A German anatomist says that we have the vestiges of one hundred and eighty organs which have stuck to us from our animal ancestors, — now useless, or often worse than useless, like the vermiform appendix. Eleven of these superannuated and obsolete organs we bring from the fishes, four from amphibians and reptiles. The external ear is a ves-

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tige — of no use any more. Our dread of snakes we no doubt inherited from our simian ancestors.

How life refined and humanized as time went on, sobered down and became more meditative, keeping step, no doubt, with the amelioration of the soil out of which all life finally comes. Life's bank account in the soil was constantly increasing; more and more of the inorganic was wrought up into the organic; the value of every clod underfoot was raised. The riot of gigantic forms ceased, and they became ashes. The giant and uncouth vegetation ceased, and left ashes or coal. The beech, the maple, the oak, the olive, the palm came in. The giant sea-serpents disappeared; the horse, the ox, the swine, the dog, the quail, the dove came in. The placental mammals developed. The horse grew in size and beauty. When we first come upon his trail, he is a four-hoof-toed animal no larger than a fox. Later on we find him the size of a sheep with one of his toes gone; still later — many hundred thousand years, no doubt — we find him the size of a donkey, with still fewer toes, and so on till we reach the superb creature we know.

The creative energy seems to have worked in geologic time and in the geologic field just as it works here and now, in yonder vineyard or in yonder marsh, — blindly, experimentally, but persistently and successfully. The winged seeds find their proper soil, because they search in every direction; the

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climbing vines find their support, because in the same blind way they feel in all directions. Plants and animals and races of men grope their way to new fields, to new powers, to new inventions.

Indeed, how like an inventor Nature has worked, constantly improving her models, adding to and changing as experience would seem to dictate! She has developed her higher and more complex forms as man has developed his printing-press, or steam-engine, from rude, simple beginnings. From the two-chambered heart of the fish she made the treble-chambered heart of the frog, and then the four-chambered heart of the mammal. The first mammary gland had no nipples; the milk oozed out and was licked off by the young. The nipple was a great improvement, as was the power of suckling in the young.

Experimenting and experimenting endlessly, taking a forward step only when compelled by necessity,— this is the way of Nature, — experimenting with eyes, with ears, with teeth, with limbs, with feet, with toes, with wings, with bladders and lungs, with scales and armors, hitting upon the backbone only after long trials with other forms, hitting upon the movable eye only after long ages of other eyes, hitting on the mammal only after long ages of egg-laying vertebrates, hitting on the placenta only recently,— experimenting all around the circle, discarding and inventing, taking ages to perfect

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the nervous system, ages and ages to develop the centralized ganglia, the brain. First life was like a rabble, a mob, without thought or head, then slowly organization went on, as it were, from family to clan, from clan to tribe, from tribe to nation, or centralized government — the brain of man — all parts duly subordinated and directed, — millions of cells organized and working on different functions to one grand end, — coöperation, fraternization, division of labor, altruism, etc.

The cell was the first invention; it is the unit of life, — a speck of protoplasm with a nucleus. To educate this cell till it could combine with its fellows and form the higher animals seems to have been the aim of the creative energy. First the cell, then combinations of cells, then combinations of combinations, then more and more complex combinations till the body of man is reached, where endless confraternities of cells, all with different functions, working to build and sustain different organs, — brain, heart, liver, muscles, nerves, — yet all working together for one grand end — the body and mind of man. In their last analysis, all made up of the same cells — their combinations and organization making the different forms.

Evolution touches all forms but tarries with few. Many are called but few are chosen — chosen to lead the man-impulse upward. Myriads of forms are left behind, like driftwood caught in the eddies

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of a current. The clam has always remained a clam, the oyster remained an oyster. The cockroach is about the same creature to-day that it was untold æons ago; so is the shark, and so are many other forms of marine life. Often where old species have gone out and new come in, no progress has been made.

Evolution concentrates along certain lines. The biological tree behaves like another tree, branches die and drop off (species become extinct), others mature and remain, while some central shoot pushes upward. Many of the huge reptilian and mammalian branches perished in comparatively late times.

As nothing is more evident than that the same measure of life or of vital energy — power of growth, power of resistance, power of reproduction — is not meted out equally to all the individuals of a species, or to all species, so it is evident that this power of progressive development is not meted out equally to all races of mankind, or to all of the individuals of the same race. The central impulse of development seems to have come from the East, in historic times at least, and to have followed the line of the Mediterranean, to have culminated in Europe. And this progress has certainly been the work of a few minds — minds exceptionally endowed.

For the most part the barbarian races do not progress. Their exceptional minds or characters do not lead the tribes to higher planes of thought. In all

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countries we still see these barbarous people which man in his progress has left behind. Our civilization is like a field of light that fades off into shadows and darkness. There is this margin of undeveloped humanity on all sides. Always has it been so in the animal life of the globe; the higher forms have been pushed up from the lower, and the lower have remained and continued to multiply unchanged.

It seems as if some central and cherished impulse had pushed on through each form, and by successive steps had climbed from height to height, gaining a little here and a little there, intensifying and concentrating as time went on, very vague and diffuse at first, embryonic so to speak, during the first half of the great geologic year, but quickening more and more, differentiating more and more, delayed and defeated many times, no doubt, yet never destroyed, leaving form after form unchanged behind it, till it at last reached its goal in man.

After evolution has done all it can do for us toward solving the mystery of creation, much remains unsolved.

Through evolution we see creation in travail-pains for millions of years to bring forth the varied forms of life as we know them; but the mystery of the inception of this life, and of the origin of the laws that have governed its development, remains. What lies back of it all? Who or what planted the germ of the biological tree, and predetermined all

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its branches? What determined one branch to eventuate in man, another in the dog, the horse, the bird, or the reptile?

From the finite or human point of view we feel compelled to say some vaster being or intelligence must have had the thought of all these things from the beginning or before the beginning.

It is quite impossible for me to believe that fortuitous variation — variation all around the circle — could have resulted in the evolution of man. There must have been a predetermined tendency to variation in certain directions. To introduce chance into the world is to introduce chaos. No more would the waters of the interiors of the continents find their way to the sea, were there not a slant in that direction, than could haphazard variation, though checked and controlled by natural selection, result in the production of the race of man. This view may be only the outcome of our inevitable anthropomorphism which we cannot escape from, no matter how deep we dive or high we soar.

II

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I

IN making the journey to the great Southwest, — Colorado, New Mexico, and Arizona, — if one does not know his geology, he is pretty sure to wish he did, there is so much geology scattered over all these Southwestern landscapes, crying aloud to be read. The book of earthly revelation, as shown by the great science, lies wide open in that land, as it does in few other places on the globe. Its leaves fairly flutter in the wind, and the print is so large that he who runs on the California Limited may read it. Not being able to read it at all, or not taking any interest in it, is like going to Rome or Egypt or Jerusalem, knowing nothing of the history of those lands.

Of course, we have just as much geology in the East and Middle West, but the books are closed and sealed, as it were, by the enormous lapse of time since these portions of the continent became dry land. The eroding and degrading forces have ages since passed the meridian of their day's work, and grass and verdure hide their footsteps. But in the great West and Southwest, the gods of erosion and

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degradation seem yet in the heat and burden of the day's toil. Their unfinished landscapes meet the eye on every hand. Many of the mountains look as if they were blocked out but yesterday, and one sees vast naked flood-plains, and painted deserts and bad lands and dry lake-bottoms, that suggest a world yet in the making.

Some force has scalped the hills, ground the mountains, strangled the rivers, channeled the plains, laid bare the succession of geologic ages, stripping off formation after formation like a garment, or cutting away the strata over hundreds of square miles, as we pry a slab from a rock — and has done it all but yesterday. If we break the slab in the prying, and thus secure only part of it, leaving an abrupt jagged edge on the part that remains, we have still a better likeness of the work of these great geologic quarrymen. But other workmen, invisible to our eyes, have carved these jagged edges into novel and beautiful forms.

The East is old, old! the West, with the exception of the Rocky Mountains, is of yesterday in comparison. The Hudson was an ancient river before the Mississippi was born, and the Catskills were being slowly carved from a vast plateau while the rocks that were to form many of the Western ranges were being laid down as sediment in the bottom of the sea. California is yet in her teens, while New England in comparison is an octogenarian. Just as much

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geology in the East as in the West, did I say? Not as much visible geology, not as much by many chapters of earth history, not as much by all the later formations, by most of the Mesozoic and Tertiary deposits. The vast series of sedimentary rocks since the Carboniferous age, to say nothing of the volcanic, that make up these periods, are largely wanting east of the Mississippi, except in New Jersey and in some of the Gulf States. They are recent. They are like the history of our own period compared with that of Egypt and Judea. It is mainly these later formations — the Permian, the Jurassic, the Triassic, the Cretaceous, the Eocene, — that give the prevailing features to the South-western landscape that so astonish Eastern eyes. From them come most of the petrified remains of that great army of extinct reptiles and mammals — the three-toed horse, the sabre-toothed tiger, the brontosaurus, the fin-backed lizard, the imperial mammoth, the various dinosaurs, some of them gigantic in form and fearful in aspect — that of late years have appeared in our museums and that throw so much light upon the history of the animal life of the globe. Most of the sedimentary rocks of New York and New England were laid down before these creatures existed.

Now I am not going to write an essay on the geology of the West, for I really have little first-hand knowledge upon that subject, but I would indicate

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the kind of interest in the country I was most conscious of during my recent trip to the Pacific Coast and beyond. Indeed, quite a geologic fever raged in me most of the time. The rocks attracted me more than the birds, the sculpturing of the landscapes engaged my attention more than the improvements of the farms — what Nature had done more than what man was doing. The purely scenic aspects of the country are certainly remarkable, and the human aspects interesting, but underneath these things, and striking through them, lies a vast world of time and change that to me is still more remarkable, and still more interesting. I could not look out of the car windows without seeing the spectre of geologic time stalking across the hills and plains.

As one leaves the prairie States and nears the great Southwest, he finds Nature in a new mood — she is dreaming of cañons; both cliffs and soil have cañon stamped upon them, so that your eye, if alert, is slowly prepared for the wonders of rock-carving it is to see on the Colorado. The cañon form seems inherent in soil and rock. The channels of the little streams are cañons, vertical sides of adobe soil, as deep as they are broad, rectangle grooves in the ground.

Through all this arid region nature is abrupt, angular, and sudden — the plain squarely abutting the cliff, the cliff walling the cañon; the dry water-course

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sunk in the plain like a carpenter's groove into a plank. Cloud and sky look the same as at home, but the earth is a new earth — new geologically, and new in the lines of its landscapes. It seems by the forms she develops that Nature must use tools that she long since discarded in the East. She works as if with the square and the saw and the compass, and uses implements that cut like chisels and moulding-planes. Right lines, well-defined angles, and table-like tops of buttes and mesas alternate with perfect curves, polished domes, carved needles, and fluted escarpments.

In the features of our older landscapes there is little or nothing that suggests architectural forms or engineering devices; in the Far West one sees such forms and devices everywhere.

In visiting the Petrified Forests in northern Arizona we stood on the edge of a great rolling plain and looked down upon a wide, deeply eroded stretch of country below us that suggested a vast army encampment, covered as it was with great dome-shaped, tent-like mounds of a light terra-cotta color, with open spaces like streets or avenues between them. There were hundreds or thousands of these earthy tents stretching away for twenty-five miles. Along the horizon was a gigantic stockade of red, rounded pillars, or a solid line of mosque-like temples. How unreal, how spectral it all seemed! Not a sound or sign of life in the whole painted solitude — a de-

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sented camp, or one upon which the silence of death had fallen. Here, in Carboniferous times, grew the gigantic fern-like trees, the *Sigillaria* and *Lepidodendron*, whose petrified trunks, for æons buried beneath the deposit of the Permian seas, and then, during other æons, slowly uncovered by the gentle action of the eroding rains, we saw scattered on the ground.

You first see Nature beginning to form the cañon habit in Colorado and making preliminary studies for her masterpiece, the Grand Cañon. Huge square towers and truncated cones and needles and spires break the horizon-lines. Here all her water-courses, wet or dry, are deep grooves in the soil, with striking and pretty carvings and modelings adorning their vertical sides. In the railway cuts you see the same effects — miniature domes and turrets and other cañon features carved out by the rains. The soil is massive and does not crumble like ours and seek the angle of repose; it gives way in masses like a brick wall. It is architectural soil, it seeks approximately the right angle — the level plain or the vertical wall. It erodes easily under running water, but it does not slide; sand and clay are in such proportions as to make a brittle but not a friable soil.

Before you are out of Colorado, you begin to see these novel architectural features on the horizon-line — the cañon turned bottom side up, as it were.

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In New Mexico, the cañon habit of the erosion forces is still more pronounced. The mountain-lines are often as architectural in the distance, or arbitrary, as the sky-line of a city. You may see what you half persuade yourself is a huge brick building notching the horizon, — an asylum, a seminary, a hotel, — but it is only a fragment of red sandstone, carved out by wind and rain.

Presently the high colors of the rocks appear — high cliffs with terra-cotta façades, and a new look in the texture of the rocks, a soft, beaming, less frowning expression, and colored as if by the Western sunsets. We are looking upon much younger rocks geologically than we see at home, and they have the tints and texture of youth. The landscape and the mountains look young, because they look unfinished, like a house half up. The workmen have but just knocked off work to go to dinner; their great trenches, their freshly opened quarries, their huge dumps, their foundations, their cyclopean masonry, their half-finished structures breaking the horizon-lines, their square gashes through the mountains, — all impress the eyes of a traveler from the eastern part of the continent, where the earth-building and earth-carving forces finished their work ages ago.

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II

Hence it is that when one reaches the Grand Cañon of the Colorado, if he has kept his eyes and mind open, he is prepared to see striking and unusual things. But he cannot be fully prepared for just what he does see, no matter how many pictures of it he may have seen, or how many descriptions of it he may have read.

A friend of mine who took a lively interest in my Western trip wrote me that he wished he could have been present with his kodak when we first looked upon the Grand Cañon. Did he think he could have got a picture of our souls? His camera would have shown him only our silent, motionless forms as we stood transfixed by that first view of the stupendous spectacle. Words do not come readily to one's lips, or gestures to one's body, in the presence of such a scene. One of my companions said that the first thing that came into her mind was the old text, "Be still, and know that I am God." To be still on such an occasion is the easiest thing in the world, and to feel the surge of solemn and reverential emotions is equally easy; is, indeed, almost inevitable. The immensity of the scene, its tranquillity, its order, its strange, new beauty, and the monumental character of its many forms — all these tend to beget in the beholder an attitude of silent wonder and solemn admiration. I wished at the

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moment that we might have been alone with the glorious spectacle, — that we had hit upon an hour when the public had gone to dinner. The smoking and joking tourists sauntering along in apparent indifference, or sitting with their backs to the great geologic drama, annoyed me. I pity the person who can gaze upon the spectacle unmoved. Some are actually terrified by it. I was told of a strong man, an eminent lawyer from a Western city, who literally fell to the earth at the first view, and could not again be induced to look upon it. I saw a woman prone upon the ground near the brink at Hopi Point, weeping silently and long; but from what she afterward told me I know it was not from terror or sorrow, but from the overpowering gladness of the ineffable beauty and harmony of the scene. It moved her like the grandest music. Her inebriate soul could find relief only in tears.

Harriet Monroe was so wrought up by the first view that she says she had to fight against the desperate temptation to fling herself down into the soft abyss, and thus redeem the affront which the very beating of her heart had offered to the inviolable solitude. Charles Dudley Warner said of it, "I experienced for a moment an indescribable terror of nature, a confusion of mind, a fear to be alone in such a presence."

It is beautiful, oh, how beautiful! but it is a beauty that awakens a feeling of solemnity and awe.

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We call it the "Divine Abyss." It seems as much of heaven as of earth. Of the many descriptions of it, none seems adequate. To rave over it, or to pour into it a torrent of superlatives, is of little avail. My companion came nearer the mark when she quietly repeated from Revelation, "And he carried me away in the spirit to a great and high mountain, and shewed me that great city, the holy Jerusalem." It does, indeed, suggest a far-off, half-sacred antiquity, some greater Jerusalem, Egypt, Babylon, or India. We speak of it as a scene: it is more like a vision, so foreign is it to all other terrestrial spectacles, and so surpassingly beautiful.

To ordinary folk the sight is so extraordinary, so unlike everything one's experience has yielded, and so unlike the results of the usual haphazard working of the blind forces of nature, that I did not wonder when people whom I met on the rim asked me what I supposed did all this. I could even sympathize with the remark of an old woman visitor who is reported to have said that she thought they had built the cañon too near the hotel. The enormous cleavage which the cañon shows, the abrupt drop from the brink of thousands of feet, the sheer faces of perpendicular walls of dizzy height, give at first the impression that it is all the work of some titanic quarryman, who must have removed cubic miles of strata as we remove cubic yards of earth.

Go out to Hopi Point or O'Neil's Point, and, as

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you emerge from the woods, you get a glimpse of a blue or rose-purple gulf opening before you. The solid ground ceases suddenly, and an aerial perspective, vast and alluring, takes its place; another heaven, countersunk in the earth, transfixes you on the brink. "Great God!" I can fancy the first beholder of it saying, "what is this? Do I behold the transfiguration of the earth? Has the solid ground melted into thin air? Is there a firmament below as well as above? Has the earth veil at last been torn aside, and the red heart of the globe been laid bare?" If this first witness was not at once overcome by the beauty of the earthly revelation before him, or terrified by its strangeness and power, he must have stood long, awed, spellbound, speechless with astonishment, and thrilled with delight. He may have seen vast and glorious prospects from mountain-tops, he may have looked down upon the earth and seen it unroll like a map before him; but he had never before looked *into* the earth as through a mighty window or open door, and beheld depths and gulfs of space, with their atmospheric veils and illusions and vast perspectives, such as he had seen from mountain-summits, but with a wealth of color and a suggestion of architectural and monumental remains, and a strange, almost unearthly beauty, such as no mountain-view could ever have afforded him.

Three features of the cañon strike one at once: its unparalleled magnitude, its architectural forms and

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suggestions, and its opulence of color effects — a chasm nearly a mile deep and from ten to twenty miles wide, in which Niagara would be only as a picture upon your walls, in which the Pyramids, seen from the rim, would appear only like large tents, in which the largest building upon the earth would dwindle to insignificant proportions. There are amphitheatres and mighty aisles eight miles long and three or four miles wide and three or four thousand feet deep. There are room-like spaces eight hundred feet high; there are well-defined alcoves with openings a mile wide; there are niches six hundred feet high overhung by arched lintels; there are pinnacles and rude statues from one hundred to two hundred feet high. Here I am running at once into allusions to the architectural features and suggestions of the cañon, which must play a prominent part in all faithful attempts to describe it. There are huge, truncated towers, vast, horizontal mouldings; there is the semblance of balustrades on the summit of a noble façade. In one of the immense halls we saw, on an elevated platform, the outlines of three enormous chairs, fifty feet or more high, and behind and above them the suggestion of three more chairs in partial ruin. Indeed, there is such an opulence of architectural forms in this divine abyss as one has never before dreamed of seeing wrought by the blind forces of nature. These forces have here foreshadowed all the noblest archi-

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ture of the world. Many of the vast carved and ornamental masses which diversify the cañon have been fitly named temples, as Shiva's Temple, a mile high, carved out of the red Carboniferous limestone, and remarkably symmetrical in its outlines. Near it is the Temple of Isis, the Temple of Osiris, the Buddha Temple, the Horus Temple, and the Pyramid of Cheops. Farther to the east is the Diva Temple, the Brahma Temple, the Temple of Zoroaster, and the Tomb of Odin. Indeed, everywhere are there suggestions of temples and tombs, pagodas and pyramids, on a scale that no work of human hands can rival. "The grandest objects," says Major Dutton, "are merged in a congregation of others equally grand." With the wealth of form goes a wealth of color. Never, I venture to say, were reds and browns and grays and vermilions more appealing to the eye than they are as they softly glow in this great cañon. The color-scheme runs from the dark, sombre hue of the gneiss at the bottom, up through the yellowish brown of the Cambrian layers, and on up through seven or eight broad bands of varying tints of red and vermilion, to the broad yellowish-gray at the top.

III

The north side of the cañon has been much more deeply and elaborately carved than the south side; most of the great architectural features are on the north side — the huge temples and fortresses and

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amphitheatres. The strata dip very gently to the north and northeast, while the slope of the surface is to the south and southeast. This has caused the drainage from the great northern plateaus to flow into the cañon and thus cut and carve the north side as we behold it.

The visitor standing upon the south side looks across the great chasm upon the bewildering maze of monumental forms, some of them as suggestive of human workmanship as anything in nature well can be, — crumbling turrets and foundations, forms as distinctly square as any work of man's hands, vast fortress-like structures with salients and entering angles and wing walls resisting the siege of time, huge pyramidal piles rising story on story, three thousand feet or more above their foundations, each successive story or superstructure faced by a huge vertical wall which rises from a sloping talus that connects it with the story next below. The slopes or taluses represent the softer rock, the vertical walls the harder layers. Usually four or five of these receding stories make up each temple or pyramid. Some of the larger structures show all the strata from the cap of light Carboniferous limestone at the top to the gray Cambrian sandstone at the bottom. From others, such as the Temple of Isis, all the upper formations are gone with a pile of disintegrated red sandstone, like a mass of brick dust on the top where the fragment of the old red wall made

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its last stand. In those masses, which are still crowned with the light gray limestone, one sees how surely the process of disintegration is going on by the fragments and débris of light gray rock, like the chips of giant workmen, that strew the deeper-colored slopes below them. These fragments fade out as the eye drops down the slopes, as if they had melted like bits of ice. Indeed, the melting of ice and the dissolution of a rock do not differ much except that one is very rapid and the other infinitely slow. In time (not man's time, but the Lord's time), all these light masses that cap the huge temples will be weathered away, yea, and all the vast red layers beneath them, and the huge structures will be slowly consumed by time. The Colorado River will carry their ashes to the sea, and where they once stood will be seen gray, desert-like plateaus. Their outlines now stand out like skeletons from which the flesh has been removed — sharp, angular, obtrusive, but bound together as by ligaments of granite. The tooth of time gnaws at them day and night and has been gnawing for thousands of centuries, so that in some cases only their stumps remain. From the Temple of Isis and the Tomb of Odin the two or three upper stories are gone.

On the next page is the ground plan of the Temple of Isis, about twenty-five hundred feet high. The first story is about a thousand feet; the second, three hundred and fifty feet; the third, one hundred and

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fifty feet; the fourth, five hundred feet; and the fifth, five hundred feet. The finish at the top shows



as a heavy crumbling wall, probably one hundred feet or more high. How the mass seems to be resisting the siege of time, throwing out its salients here and there,

and meeting the onset of the foes like a military engineer.

The pyramidal form of these rock-masses is accounted for by the fact that they were carved out from the top downward, and that each successive story is vastly older than the one immediately beneath it. The erosive forces have been working whole geologic ages longer on the top layer of rock than on the bottom layer; hence the topmost ones are entirely gone or else reduced to small dimensions. But what feature or quality of the rock it is that lends itself so readily or so inevitably to these architectural forms — the four square foundations, the end pilasters and balustrades, and so on — is to me not so clear. The peculiar rectangular jointings, the alternation of soft and hard layers, the nearly horizontal strata, and other things, no doubt, enter into the problem. Many of these features are found in our older geology of the East, as in the Catskills — horizontal strata, hard and soft layers alternating, but with the vertical jointing less pronounced;

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hence the Catskills have few cañon-like valleys, though there are here and there huge gashes through the mountains that give a cañon effect, and there are gigantic walls high up on the face of some of the mountains that suggest one side of a mighty cañon. In the climate of the Catskills the rock-masses of the Colorado would crumble much more rapidly than they do here. The lines of many of these natural temples or fortresses are still more lengthened and attenuated than those of the Temple of Isis, appearing like mere skeletons of their former selves. The forms that weather out the formation above this, the Permian, appear to be more rotund, and tend more to domes and rounded hills.

One of the most surprising features of the Grand Cañon is its cleanness—its freedom from débris. It is a home of the gods, swept and garnished; no litter or confusion or fragments of fallen and broken rocky walls anywhere. Those vast sloping taluses are as clean as a meadow; rarely at the foot of the huge vertical walls do you see a fragment of fallen rock. It is as if the processes of erosion and degradation were as gentle as the dews and the snows, and carved out this mighty abyss grain by grain, which has probably been the case. That much of this red sandstone, from the amount of iron it contains, or from some other cause, disintegrates easily and rapidly, is very obvious. Looking down from Hopi Point upon a vast ridge called the “Man-of-

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War," one sees on the top, where once there must have been a huge wall of rock, a long level area of red soil that suggests a garden, the more so because it is regularly divided up into sections by straight lines of huge stone placed as if by the hands of man.

One's sense of the depths of the cañon is so great that it almost makes one dizzy to see the little birds fly out over it, or plunge down into it. One seems to fear that they too will get dizzy and fall to the bottom. We watched a line of tourists on mules creeping along the trail across the inner plateau, and the unaided eye had trouble to hold them; they looked like little red ants. The eye has more difficulty in estimating sizes and distances beneath it than when they are above or on a level with it, because it is so much less familiar with depth than with height or lateral dimensions.

Another remarkable and unexpected feature of the cañon is its look of ordered strength. Nearly all the lines are lines of greatest strength. The prevailing profile line everywhere is that shown herewith. The upright lines represent lines of cyclopean masonry, and the slant is the talus that connects them, covered with a short, sage-colored growth of some kind, and as soft to the eye as the turf of our fields.

The simple, strong structural lines assert them-

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selves everywhere, and give that look of repose and security characteristic of the scene. The rocky forces always seem to retreat in good order before the onslaught of time; there is neither rout nor confusion; everywhere they present a calm upright front to the foe. And the fallen from their ranks, where are they? A cleaner battlefield between the forces of nature one rarely sees.

The weaker portions are, of course, constantly giving way. The elements incessantly lay siege to these fortresses and take advantage of every flaw or unguarded point, so that what stands has been seven times, yea, seventy times seven times tested, and hence gives the impression of impregnable strength. The angles and curves, the terraces and foundations, seem to be the work of some master engineer, with only here and there a toppling rock.

I was puzzled to explain to myself the reason of a certain friendly and familiar look which the great abyss had for me. One sees or feels at a glance that it was not born of the throes and convulsions of nature — of earthquake shock or volcanic explosion. It does not suggest the crush of matter and the wreck of worlds. Clearly it is the work of the more gentle and beneficent forces. This probably accounts for the friendly look. Some of the inner slopes and plateaus seemed like familiar ground to me: I must have played upon them when a school-boy. Bright Angel Creek, for some inexplicable reason, recalled

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a favorite trout-stream of my native hills, and the old Cambrian plateau that edges the inner chasm, as we looked down upon it from nearly four thousand feet above, looked like the brown meadow where we played ball in the old school-days, friendly, tender, familiar, in its slopes and terraces, in its tints and basking sunshine, but grand and awe-inspiring in its depths, its huge walls, and its terrific precipices.

The geologists are agreed that the cañon is only of yesterday in geologic time, — the Middle Tertiary, — and yet behold the duration of that yesterday as here revealed, probably a million years or more! We can no more form any conception of such time than we can of the size of the sun or of the distance of the fixed stars.

The forces that did all this vast delving and sculpturing — the air, the rains, the frost, the sunshine — are as active now as they ever were; but their activity is a kind of slumbering that rarely makes a sign. Only at long intervals is the silence of any part of the profound abyss broken by the fall of loosened rocks or sliding talus. We ourselves saw where a huge splinter of rock had recently dropped from the face of the cliff. In time these loosened masses disappear, as if they melted like ice. A city not made with hands, but as surely not eternal in the earth! In our humid and severe Eastern climate, frost and ice and heavy rains working together, all these architectural forms would have crumbled long ago, and

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fertile fields or hill-slopes would have taken their place. In the older Hawaiian Islands, which probably also date from Tertiary times, the rains have carved enormous cañons and amphitheatres out of the hard volcanic rock, in some places grinding the mountains to such a thin edge that a man may literally sit astride them, each leg pointing into opposite valleys. In the next geologic age, the temples and monuments of the Grand Cañon will have largely disappeared, and the stupendous spectacle will be mainly a thing of the past.

It seems to take millions of years to tame a mountain, to curb its rude, savage power, to soften its outlines, and bring fertility out of the elemental crudeness and barrenness. But time and the gentle rains of heaven will do it, as they have done it in the East, and as they are fast doing it in the West.

An old guide with whom I talked, who had lived in and about the cañon for twenty-six years, said, "While we have been sitting here, the cañon has widened and deepened"; which was, of course, the literal truth, the mathematical truth, but the widening and deepening could not have been apprehended by human sense.

Our little span of human life is far too narrow for us to be a witness of any of the great earth changes. These changes are so slow, — oh, so slow, — and human history is so brief. So far as we are concerned, the gods of the earth sit in council behind closed

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doors. All the profound, formative, world-shaping forces of nature go on in a realm that we can reach only through our imaginations. They so far transcend our human experiences that it requires an act of faith to apprehend them. The repose of the hills and the mountains, how profound! yet they may be rising or sinking before our very eyes, and we detect no sign. Only on exceptional occasions, during earthquakes or volcanic eruptions, is their dreamless slumber rudely disturbed.

Geologists tell us that from the great plateau in which the Grand Cañon is cut, layers of rock many thousands of feet thick were cut away before the cañon was begun.

Starting from the high plateau of Utah, and going south toward the cañon, we descend a grand geologic stairway, every shelf or tread of which consists of different formations fifty or more miles broad, from the Eocene, at an altitude of over ten thousand feet at the start, across the Cretaceous, the Jurassic, the Triassic, the Permian, to the Carboniferous, which is the bottom or landing of the Grand Cañon plateau at an altitude of about five thousand feet. Each step terminates more or less abruptly, the first by a drop of eight hundred feet, ornamented by rows of square obelisks and pilasters of uniform pattern and dimension, "giving the effect," says Major Dutton, "of a gigantic colonnade from which the entablature has been removed or has fallen in ruins."

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The next step, or platform, the Cretaceous, slopes down gradually or dies out on the step beneath it; then comes the Jurassic, which ends in white sandstone cliffs several hundred feet high; then the Triassic, which ends in the famous vermilion cliffs thousands of feet high, most striking in color and in form; then the Permian tread, which also ends in striking cliffs, with their own style of color and architecture; and, lastly, the great Carboniferous platform in which the cañon itself is carved. Now, all these various strata above the cañon, making at one time a thickness of over a mile, were worn away in Pliocene times, before the cutting of the Grand Cañon began. Had they remained, and been cut through, we should have had a chasm two miles deep instead of one mile.

The cutting power of a large, rapid volume of water, like the Colorado, charged with sand and gravel, is very great. According to Major Dutton, in the hydraulic mines of California, the escaping water has been known to cut a chasm from twelve to twenty feet deep in hard basaltic rock, in a single year. This is, of course, exceptional, but there have, no doubt, been times when the Colorado cut downward very rapidly. The enormous weathering of its side walls is to me the more wonderful, probably because the forces that have achieved this task are silent and invisible, and, so far as our experience goes, so infinitely slow in their action.

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The river is a tremendous machine for grinding and sawing and transporting, but the rains and the frost and the air and the sunbeams smite the rocks as with weapons of down, and one is naturally incredulous as to their destructive effects.

Some of the smaller rivers in the plateau region flow in very deep but very narrow cañons. The rocks being harder and more homogeneous, the weathering has been slight. The meteoric forces have not taken a hand in the game. Thus the Parunuweap Cañon is only twenty to thirty feet wide, but from six hundred to fifteen hundred feet deep.

I suppose the slow, inappreciable erosion to which the old guide alluded would have cut the cañon since Middle Tertiary times. The river, eating downward at the rate of one sixteenth of an inch a year, would do it in about one million years. At half that rate it would do it in double that time. In the earlier part of its history, when the rainfall was doubtless greater, and the river fuller, the erosion must have been much more rapid than it is at present. The widening of the cañon was doubtless a slower process than the downward cutting. But, as I have said, the downward cutting would tend to check itself from age to age, while the widening process would go steadily forward. Hence, when we look into the great abyss, we have only to remember the enormous length of time that the aerial and sub-aerial forces have been at work to account for it.

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Two forces, or kinds of forces, have worked together in excavating the cañon: the river, which is the primary factor, and the meteoric forces, which may be called the secondary, as they follow in the wake of the former. The river starts the gash downward, then the aerial forces begin to eat into the sides. Acting alone, the river would cut a trench its own width, and were the rocks through which it saws one homogeneous mass, or of uniform texture and hardness, the width of the trench would probably have been very uniform and much less than it is now. The condition that has contributed to its great width is the heterogeneity of the different formations — some hard and some soft. The softer bands, of course, introduce the element of weakness. They decay and crumble the more rapidly, and thus undermine the harder bands overlying them, which, by reason of their vertical fractures, break off and fall to the bottom, where they are exposed to the action of floods and are sooner or later ground up in the river's powerful maw. Hence the recession of the banks of the cañon has gone steadily on with the downward cutting of the river. Where the rock is homogeneous, as it is in the inner chasm of the dark gneiss, the widening process seems to have gone on much more slowly. Geologists account for the great width of the main chasm when compared with the depth, on the theory that the forces that work laterally have been more continuously active than has

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the force that cuts downward. There is convincing evidence that the whole region has been many times lifted up since the cutting began, so that the river has had its active and passive stages. As its channel approached the sea level, its current would be much less rapid, and the downward cutting would practically cease, till the section was elevated again. But all the time the forces working laterally would be at work without interruption, and would thus gain on their checked brethren of the river bottom.

There is probably another explanation of what we see here. Apart from the mechanical weathering of the rocks as a result of the arid climate, wherein rapid and often extreme changes of temperature take place, causing the surface of the rocks to flake or scale off, there has doubtless been unusual chemical weathering, and this has been largely brought about by the element of iron that all these rocks possess. Their many brilliant colors are imparted to them by the various compounds of iron which enter into their composition. And iron, though the symbol of hardness and strength, is an element of weakness in rocks, as it causes them to oxidize or disintegrate more rapidly. In the marble cañon, where apparently the rock contains no iron, the lateral erosion has been very little, though the river has cut a trench as deep as it has in other parts of its course.

How often I thought during those days at the

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cañon of the geology of my native hills amid the Catskills, which show the effects of denudation as much older than that shown here as this is older than the washout in the road by this morning's shower! The old red sandstone in which I hoed corn as a farm-boy dates back to Middle Palæozoic time, or to the spring of the great geologic year, while the cañon is of the late autumn. Could my native hills have replied to my mute questionings, they would have said: "We were old, old, and had passed through the cañon stage long before the Grand Cañon was born. We have had all that experience, and have forgotten it ages ago. No vestiges of our cañons remain. They have all been worn down and obliterated by the strokes of a hand as gentle as that of a passing cloud. Where they were, are now broad, fertile valleys, with rounded knolls and gentle slopes, and the sound of peaceful husbandry. The great ice sheet rubbed us and ploughed us, but our contours were gentle and rounded æons before that event. When the Grand Cañon is as old as we are, all its superb architectural features will have long since disappeared, its gigantic walls will have crumbled, and rolling plains and gentle valleys will have taken its place." All of which seems quite probable. With time enough, the gentle forces of air and water will surely change the whole aspect of this tremendous chasm.

On the second day we made the descent into the

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cañon on mule-back. There is always satisfaction in going to the bottom of things. Then we wanted to get on more intimate terms with the great abyss, to wrestle with it, if need be, and to feel its power, as well as to behold it. It is not best always to dwell upon the rim of things or to look down upon them from afar. The summits are good, but the valleys have their charm, also; even the valley of humiliation has its lessons. At any rate, four of us were unanimous in our desire to sound that vast profound on mule-back, trusting that the return trip would satisfy our "climbing" aspirations, as it did.

It is quite worth while to go down into the cañon on mule-back, if only to fall in love with a mule, and to learn what a sure-footed, careful, and docile creature, when he is on his good behavior, a mule can be. My mule was named "Johnny," and there was soon a good understanding between us. I quickly learned to turn the whole problem of that perilous descent over to him. He knew how to take the sharp turns and narrow shelves of that steep zigzag much better than I did. I do not fancy that the thought of my safety was "Johnny's" guiding star; his solicitude struck nearer home than that. There was much ice and snow on the upper part of the trail, and only those slender little legs of "Johnny's" stood between me and a tumble of two or three thousand feet. How cautiously he felt his

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way with his round little feet, as, with lowered head, he seemed to be scanning the trail critically! Only when he swung around the sharp elbows of the trail did his forefeet come near the edge of the brink. Only once or twice at such times, as we hung for a breath above the terrible incline, did I feel a slight shudder. One of my companions, who had never before been upon an animal's back, so fell in love with her "Sandy" that she longed for a trunk big enough in which to take him home with her.

It was more than worth while to make the descent to traverse that Cambrian plateau, which from the rim is seen to flow out from the base of the enormous cliffs to the brink of the inner chasm, looking like some soft, lavender-colored carpet or rug. I had never seen the Cambrian rocks, the lowest of the stratified formations, nor set my foot upon Cambrian soil. Hence a new experience was promised me. Rocky layers probably two or three miles thick had been worn away from the old Cambrian foundations, and when I looked down upon that gently undulating plateau, the thought of the eternity of time which it represented tended quite as much to make me dizzy as did the drop of nearly four thousand feet. We found it gravelly and desert-like, covered with cacti, low sagebrush, and other growths. The dim trail led us to its edge, where we could look down into the twelve-hundred-foot V-shaped gash which the river had cut into the dark, crude-looking

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Archæan rock. How distinctly it looked like a new day in creation where the horizontal, yellowish-gray beds of the Cambrian were laid down upon the dark, amorphous, and twisted older granite! How carefully the level strata had been fitted to the shapeless mass beneath it! It all looked like the work of a master mason; apparently you could put the point of your knife where one ended and the other began. The older rock suggested chaos and turmoil; the other suggested order and plan, as if the builder had said, "Now upon this foundation we will build our house." It is an interesting fact, the full geologic significance of which I suppose I do not appreciate, that the different formations are usually marked off from one another in just this sharp way, as if each one was, indeed, the work of a separate day of creation. Nature appears at long intervals to turn over a new leaf and start a new chapter in her great book. The transition from one geologic age to another appears to be abrupt: new colors, new constituents, new qualities appear in the rocks with a suddenness hard to reconcile with Lyell's doctrine of uniformitarianism, just as new species appear in the life of the globe with an abruptness hard to reconcile with Darwin's slow process of natural selection. Is sudden mutation, after all, the key to all these phenomena?

We ate our lunch on the old Cambrian table, placed there for us so long ago, and gazed down upon the turbulent river hiding and reappearing in

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its labyrinthian channel so far below us. It is worth while to make the descent in order to look upon the river which has been the chief quarryman in excavating the cañon, and to find how inadequate it looks for the work ascribed to it. Viewed from where we sat, I judged it to be forty or fifty feet broad, but I was assured that it was between two and three hundred feet. Water and sand are ever symbols of instability and inconstancy, but let them work together, and they saw through mountains, and undermine the foundations of the hills.

It is always worth while to sit or kneel at the feet of grandeur, to look up into the placid faces of the earth gods and feel their power, and the tourist who goes down into the cañon certainly has this privilege. We did not bring back in our hands, or in our hats, the glory that had lured us from the top, but we seemed to have been nearer its sources, and to have brought back a deepened sense of the magnitude of the forms, and of the depth of the chasm which we had heretofore gazed upon from a distance. Also we had plucked the flower of safety from the nettle danger, always an exhilarating enterprise.

In climbing back, my eye, now sharpened by my geologic reading, dwelt frequently and long upon the horizon where that cross-bedded Carboniferous sandstone joins the Carboniferous limestone above it. How much older the sandstone looked! I could not avoid the impression that its surface must have

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formed a plane of erosion ages and ages before the limestone had been laid down upon it.

We had left plenty of ice and snow at the top, but in the bottom we found the early spring flowers blooming, and a settler at what is called the Indian Gardens was planting his garden. Here I heard the song of the cañon wren, a new and very pleasing bird-song to me. I think our dreams were somewhat disturbed that night by the impressions of the day, but our day-dreams since that time have at least been sweeter and more comforting, and I am sure that the remainder of our lives will be the richer for our having seen the Grand Cañon.

III

THE SPELL OF THE YOSEMITE

I

YOSEMITE won my heart at once, as it seems to win the hearts of all who visit it. In my case many things helped to do it, but I am sure a robin, the first I had seen since leaving home, did his part. He struck the right note, he brought the scene home to me, he supplied the link of association. There he was, running over the grass or perching on the fence, or singing from a tree-top in the old familiar way. Where the robin is at home, there at home am I. But many other things helped to win my heart to the Yosemite — the whole character of the scene, not only its beauty and sublimity, but the air of peace and protection, and of homelike seclusion that pervades it; the charm of a nook, a retreat, combined with the power and grandeur of nature in her sternest moods.

After passing from the hotel at El Portal along the foaming and roaring Merced River, and amid the tumbled confusion of enormous granite boulders shaken down from the cliffs above, you cross the threshold of the great valley as into some vast house or hall carved out of the mountains, and at once feel

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the spell of the brooding calm and sheltered seclusion that pervades it. You pass suddenly from the tumultuous, the chaotic, into the ordered, the tranquil, the restful, which seems enhanced by the power and grandeur that encompass them about. You can hardly be prepared for the hush that suddenly falls upon the river and for the gentle rural and sylvan character of much that surrounds you; the peace of the fields, the seclusion of the woods, the privacy of sunny glades, the enchantment of falls and lucid waters, with a touch of human occupancy here and there — all this, set in that enormous granite frame, three or four thousand feet high, ornamented with domes and spires and peaks still higher,— it is all this that wins your heart and fills your imagination in the Yosemite.

As you ride or walk along the winding road up the level valley amid the noble pines and spruces and oaks, and past the groves and bits of meadow and the camps of many tents, and the huge mossy granite boulders here and there reposing in the shade of the trees, with the full, clear, silent river winding through the plain near you, you are all the time aware of those huge vertical walls, their faces scarred and niched, streaked with color, or glistening with moisture, and animated with waterfalls, rising up on either hand, thousands of feet high, not architectural, or like something builded, but like the sides and the four corners of the globe itself. What an

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impression of mass and of power and of grandeur in repose filters into you as you walk along! El Capitan stands there showing its simple sweeping lines through the trees as you approach, like one of the veritable pillars of the firmament. How long we are nearing it and passing it! It is so colossal that it seems near while it is yet far off. It is so simple that the eye takes in its naked grandeur at a glance. It demands of you a new standard of size which you cannot at once produce. It is as clean and smooth as the flank of a horse, and as poised and calm as a Greek statue. It curves out toward the base as if planted there to resist the pressure of worlds — probably the most majestic single granite column or mountain buttress on the earth. Its summit is over three thousand feet above you. Across the valley, nearly opposite, rise the Cathedral Rocks to nearly the same height, while farther along, beyond El Capitan, the Three Brothers shoulder the sky at about the same dizzy height. Near the head of the great valley, North Dome, perfect in outline as if turned in a lathe, and its brother, the Half Dome (or shall we say half-brother?) across the valley, look down upon Mirror Lake from an altitude of over four thousand feet. These domes suggest enormous granite bubbles if such were possible pushed up from below and retaining their forms through the vast geologic ages. Of course they must have weathered enormously, but as the rock seems to

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peel off in concentric sheets, their forms are preserved.

II

One warm, bright Sunday near the end of April, six of us walked up from the hotel to Vernal and Nevada Falls, or as near to them as we could get, and took our fill of the tumult of foaming waters struggling with the wreck of huge granite cliffs: so impassive and immobile the rocks, so impetuous and reckless and determined the onset of the waters, till the falls are reached, when the obstructed river seems to find the escape and the freedom it was so eagerly seeking. Better to be completely changed into foam and spray by one single leap of six hundred feet into empty space, the river seems to say, than be forever baffled and tortured and torn on this rack of merciless boulders.

We followed the zigzagging trail up the steep side of the valley, touching melting snow-banks in its upper courses, passing huge granite rocks also melting in the slow heat of the geologic ages, pausing to take in the rugged, shaggy spruces and pines that sentineled the mountain-sides here and there, or resting our eyes upon Liberty Cap, which carries its suggestive form a thousand feet or more above the Nevada Fall. What beauty, what grandeur attended us that day! the wild tumult of waters, the snow-white falls, the motionless avalanches of

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granite rocks, and the naked granite shaft, Liberty Cap, dominating all!

And that night, too, when we sat around a big camp-fire near our tents in the valley, and saw the full moon come up and look down upon us from behind Sentinel Rock, and heard the intermittent booming of Yosemite Falls sifting through the spruce trees that towered around us, and felt the tender, brooding spirit of the great valley, itself touched to lyric intensity by the grandeurs on every hand, steal in upon us, and possess our souls—surely that was a night none of us can ever forget. As Yosemite can stand the broad, searching light of mid-day and not be cheapened, so its enchantments can stand the light of the moon and the stars and not be rendered too vague and impalpable.

III

Going from the Grand Cañon to Yosemite is going from one sublimity to another of a different order. The cañon is the more strange, unearthly, apocryphal, appeals more "to the imagination, and is the more overwhelming in its size, its wealth of color, and its multitude of suggestive forms. But for quiet majesty and beauty, with a touch of the sylvan and pastoral, too, Yosemite stands alone. One could live with Yosemite, camp in it, tramp in it, winter and summer in it, and find nature in her tender and human, almost domestic moods, as well as in her

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grand and austere. But I do not think one could ever feel at home in or near the Grand Cañon; it is too unlike anything we have ever known upon the earth; it is like a vision of some strange colossal city uncovered from the depth of geologic time. You may have come to it, as we did, from the Petrified Forests, where you saw the silicified trunks of thousands of gigantic trees or tree ferns, that grew millions of years ago, most of them uncovered, but many of them protruding from banks of clay and gravel, and in their interiors rich in all the colors of the rainbow, and you wonder if you may not now be gazing upon some petrified antediluvian city of temples and holy places exhumed by mysterious hands and opened up to the vulgar gaze of to-day. You look into it from above and from another world and you descend into it at your peril. Yosemite you enter as into a gigantic hall and make your own; the cañon you gaze down upon, and are an alien, whether you enter it or not. Yosemite is carved out of the most majestic and enduring of all rocks, granite; the Grand Cañon is carved out of one of the most beautiful, but perishable, red Carboniferous sandstone and limestone. There is a maze of beautiful and intricate lines in the latter, a wilderness of temple-like forms and monumental remains, and noble architectural profiles that delight while they bewilder the eye. Yosemite has much greater simplicity, and is much nearer the classic standard of beauty. Its

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grand and austere features predominate, of course, but underneath these and adorning them are many touches of the idyllic and the picturesque. Its many waterfalls fluttering like white lace against its vertical granite walls, its smooth, level floor, its noble pines and oaks, its open glades, its sheltering groves, its bright, clear, winding river, its soft voice of many waters, its flowers, its birds, its grass, its verdure, even its orchards of blooming apple trees, all inclosed in this tremendous granite frame — what an unforgettable picture it all makes, what a blending of the sublime and the homelike and familiar it all is! It is the waterfalls that make the granite alive, and bursting into bloom as it were. What a touch they give! how they enliven the scene! What music they evoke from these harps of stone!

The first leap of Yosemite Falls is sixteen hundred feet — sixteen hundred feet of a compact mass of snowy rockets shooting downward and bursting into spray around which rainbows flit and hover. The next leap is four hundred feet, and the last six hundred. We tried to get near the foot and inspect the hidden recess in which this airy spirit again took on a more tangible form of still, running water, but the spray over a large area fell like a summer shower, drenching the trees and the rocks, and holding the inquisitive tourist off at a safe distance. We had to beat a retreat with dripping garments before we had got within fifty yards of the

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foot of the fall. At first I was surprised at the volume of water that came hurrying out of the hidden recess of dripping rocks and trees — a swiftly flowing stream, thirty or forty feet wide, and four or five feet deep. How could that comparatively narrow curtain of white spray up there give birth to such a full robust stream? But I saw that in making the tremendous leap from the top of the precipice, the stream was suddenly drawn out, as we stretch a rubber band in our hands, and that the solid and massive current below was like the rubber again relaxed. The strain was over, and the united waters deepened and slowed up over their rocky bed.

Yosemite for a home or a camp, the Grand Cañon for a spectacle. I have spoken of the robin I saw in Yosemite Valley. Think how forlorn and out of place a robin would seem in the Grand Cañon! What would he do there? There is no turf for him to inspect, and there are no trees for him to perch on. I should as soon expect to find him amid the pyramids of Egypt, or amid the ruins of Karnak. The bluebird was in the Yosemite also, and the water-ouzel haunted the lucid waters.

I noticed a peculiarity of the oak in Yosemite that I never saw elsewhere¹ — a fluid or outflowing condition of the growth aboveground, such as one usually sees in the roots of trees — so that it tended to en-

¹ I have since observed the same trait in the oaks in Georgia — probably a characteristic of this tree in southern latitudes.

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velop and swallow, as it were, any solid object with which it came in contact. If its trunk touched a point of rock, it would put out great oaken lips several inches in extent as if to draw the rock into its maw. If a dry limb was cut or broken off, a foot from the trunk, these thin oaken lips would slowly creep out and envelop it — a sort of Western omnivorous trait appearing in the trees.

Whitman refers to "the slumbering and liquid trees." These Yosemite oaks recall his expression more surely than any of our Eastern trees.

The reader may create for himself a good image of Yosemite by thinking of a section of seven or eight miles of the Hudson River, midway of its course, as emptied of its water and deepened three thousand feet or more, having the sides nearly vertical, with snow-white waterfalls fluttering against them here and there, the famous spires and domes planted along the rim, and the landscape of groves and glades, with its still, clear winding river, occupying the bottom.

IV

One cannot look upon Yosemite or walk beneath its towering walls without the question arising in his mind, How did all this happen? What were the agents that brought it about? There has been a great geologic drama enacted here; who or what were the star actors? There are two other valleys in this part of the Sierra, Hetch-Hetchy and King's River, that

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are almost identical in their main features, though the Merced Yosemite is the widest of the three. Each of them is a tremendous chasm in the granite rock, with nearly vertical walls, domes, El Capitans, and Sentinel and Cathedral Rocks, and waterfalls — all modeled on the same general plan. I believe there is nothing just like this trio of Yosemites anywhere else on the globe.

Guided by one's ordinary sense or judgment alone, one's judgment as developed and disciplined by the everyday affairs of life and the everyday course of nature, one would say on beholding Yosemite that here is the work of exceptional and extraordinary agents or world-building forces. It is as surprising and exceptional as would be a cathedral in a village street, or a gigantic sequoia in a grove of our balsam firs. The approach to it up the Merced River does not prepare one for any such astonishing spectacle as awaits one. The rushing, foaming water amid the tumbled confusion of huge granite rocks and the open V-shaped valley, are nothing very remarkable or unusual. Then suddenly you are on the threshold of this hall of the elder gods. Demons and furies might lurk in the valley below, but here is the abode of the serene, beneficent Olympian deities. All is so calm, so hushed, so friendly, yet so towering, so stupendous, so unspeakably beautiful. You are in a mansion carved out of the granite foundations of the earth, with walls two or three

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thousand feet high, hung here and there with snow-white waterfalls, and supporting the blue sky on domes and pinnacles still higher. Oh, the calmness and majesty of the scene! the evidence of such tremendous activity of some force, some agent, and now so tranquil, so sheltering, so beneficent!

That there should be two or three Yosemitees in the Sierra not very far apart, all with the main features singularly alike, is very significant — as if this kind of valley was latent in the granite of that region — some peculiarity of rock structure that lends itself readily to these formations. The Sierra lies beyond the southern limit of the great continental ice-sheet of late Tertiary times, but it nursed and reared many local glaciers, and to the eroding power of these its Yosemitees are partly due. But water was at work here long before the ice — eating down into the granite and laying open the mountain for the ice to begin its work. Ice may come, and ice may go, says the river, but I go on forever. Water tends to make a V-shaped valley, ice a U-shaped one, though in the Hawaiian Islands, where water erosion alone has taken place, the prevailing form of the valleys is that of the U-shaped. Yosemite approximates to this shape, and ice has certainly played a part in its formation. But the glacier seems to have stopped at the outlet of the great valley; it did not travel beyond the gigantic hall it had helped to excavate. The valley of the Merced from the mouth

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of Yosemite downward is an open valley strewn with huge angular granite rocks and shows no signs of glaciation whatever. The reason of this abruptness is quite beyond my ken. It is to me a plausible theory that when the granite that forms the Sierra was lifted or squeezed up by the shrinking of the earth, large fissures and crevasses may have occurred, and that Yosemite and kindred valleys may be the result of the action of water and ice in enlarging these original chasms. Little wonder that the earlier geologists, such as Whitney, were led to attribute the exceptional character of these valleys to exceptional and extraordinary agents — to sudden faulting or dislocation of the earth's crust. But geologists are becoming more and more loath to call in the cataclysmal to explain any feature of the topography of the land. Not to the thunder or the lightning, to earthquake or volcano, to the forces of upheaval or dislocation, but to the still, small voice of the rain and the winds, of the frost and the snow, — the gentle forces now and here active all about us, carving the valleys and reducing the mountains, and changing the courses of rivers, — to these, as Lyell taught us, we are to look in nine cases out of ten, yes, in ninety-nine out of a hundred, to account for the configuration of the continents.

The geologists of our day, while not agreeing as to the amount of work done respectively by ice and

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water, yet agree that to the latter the larger proportion of the excavation is to be ascribed. At any rate between them both they have turned out one of the most beautiful and stupendous pieces of mountain carving to be found upon the earth.

IV

THROUGH THE EYES OF THE GEOLOGIST

I

HOW habitually we go about over the surface of the earth, delving it or cultivating it or leveling it, without thinking that it has not always been as we now find it, that the mountains were not always mountains, nor the valleys always valleys, nor the plains always plains, nor the sand always sand, nor the clay always clay. Our experience goes but a little way in such matters. Such a thought takes us from human time to God's time, from the horizon of place and years to the horizon of geologic ages. We go about our little affairs in the world, sowing and reaping and building and journeying, like children playing through the halls of their ancestors, without pausing to ask how these things all came about. We do not reflect upon the age of our fields any more than we do upon the size of the globe under our feet: when we become curious about such matters and look upon the mountains as either old or young, or as the subjects of birth, growth, and decay, then we are unconscious geologists. It is to our interest in such things that geology appeals and it is this interest that it stimulates and guides.

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What an astonishing revelation, for instance, that the soil was born of the rocks, and is still born of the rocks; that every particle of it was once locked up in the primitive granite and was unlocked by the slow action of the rain and the dews and the snows; that the rocky ribs of the earth were clothed with this fertile soil out of which we came and to which we return by their own decay; that the pulling-down of the inorganic meant the building-up of the organic; that the death of the crystal meant the birth of the cell, and indirectly of you and me and of all that lives upon the earth.

Had there been no soil, had the rocks not decayed, there had been no you and me. Such considerations have long made me feel a keen interest in geology, and especially of late years have stimulated my desire to try to see the earth as the geologist sees it. I have always had a good opinion of the ground underfoot, out of which we all come, and to which we all return; and the story the geologists tell us about it is calculated to enhance greatly that good opinion.

I think that if I could be persuaded, as my fathers were, that the world was made in six days, by the fiat of a supernatural power, I should soon lose my interest in it. Such an account of it takes it out of the realm of human interest, because it takes it out of the realm of natural causation, and places it in the realm of the arbitrary, and non-natural. But to

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know that it was not made at all, in the mechanical sense, but that it grew — that it is an evolution as much as the life upon the surface, that it has an almost infinite past, that it has been developing and ripening for millions upon millions of years, a veritable apple upon the great sidereal tree, ameliorating from cycle to cycle, mellowing, coloring, sweetening — why, such a revelation adds immensely to our interest in it.

As with nearly everything else, the wonder of the world grows the more we grasp its history. The wonder of life grows the more we consider the chaos of fire and death out of which it came; the wonder of man grows the more we peer into the abyss of geologic time and of low bestial life out of which he came.

Not a tree, not a shrub, not a flower, not a green thing growing, not an insect of an hour, but has a background of a vast æon of geologic and astronomic time, out of which the forces that shaped it have emerged, and over which the powers of chaos and darkness have failed to prevail.

The modern geologist affords us one of the best illustrations of the uses of the scientific imagination that we can turn to. The scientific imagination seems to be about the latest phase of the evolution of the human mind. This power of interpretation of concrete facts, this Miltonic flight into time and space, into the heavens above, and into the bowels

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of the earth beneath, and bodying forth a veritable history, a warring of the powers of light and darkness, with the triumph of the angels of light and life, makes Milton's picture seem hollow and unreal. The creative and poetic imagination has undoubtedly already reached its high-water mark. We shall probably never see the great imaginative works of the past surpassed or even equaled. But in the world of scientific discovery and interpretation, we see the imagination working in new fields and under new conditions, and achieving triumphs that mark a new epoch in the history of the race. Nature, which once terrified man and made a coward of him, now inspires him and fills him with love and enthusiasm.

The geologist is the interpreter of the records of the rocks. From a bit of strata here, and a bit there, he re-creates the earth as it was in successive geologic periods, as Cuvier reconstructed his extinct animals from fragments of their bones; and the same interpretative power of the imagination is called into play in both cases, only the palæontologist has a much narrower field to work in, and the background of his re-creations must be supplied by the geologist.

Everything connected with the history of the earth is on such a vast scale — such a scale of time, such a scale of power, such a scale of movement — that in trying to measure it by our human standards and experience we are like the proverbial child with

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his cup on the seashore. Looked at from our point of view, the great geological processes often seem engaged in world-destruction rather than in world-building. Those oft-repeated invasions of the continents by the ocean, which have gone on from Archæan times, and during which vast areas which had been dry land for ages were engulfed, seem like world-wide catastrophes. And no doubt they were such to myriads of plants and animals of those times. But this is the way the continents grew. All the forces of the invading waters were engaged in making more land.

The geologist is bold; he is made so by the facts and processes with which he deals; his daring affirmations are inspired by a study of the features of the earth about him; his time is not our time, his horizons are not our horizons; he escapes from our human experiences and standards into the vast out-of-doors of the geologic forces and geologic ages. The text he deciphers is written large, written across the face of the continent, written in mountain-chains and ocean depths, and in the piled strata of the globe. We untrained observers cannot spell out these texts, because they are written large; our vision is adjusted to smaller print; we are like the school-boy who finds on the map the name of a town or a river, but does not see the name of the state or the continent printed across it. If the geologist did not tell us, how should we ever suspect that probably

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where we now stand two or more miles of strata have been worn away by the winds and rains; that the soil of our garden, our farm, represents the ashes of mountains burned up in the slow fires of the geologic ages.

Geology first gives us an adequate conception of time. The limitations which shut our fathers into the narrow close of six thousand years are taken down by this great science and we are turned out into the open of unnumbered millions of years. Upon the background of geologic time our chronological time shows no more than a speck upon the sky. The whole of human history is but a mere fraction of a degree of this mighty arc. The Christian era would make but a few seconds of the vast cycle of the earth's history. Geologic time! The words seem to ring down through the rocky strata of the earth's crust; they reverberate under the mountains, and make them rise and fall like the waves of the sea; they open up vistas through which we behold the continents and the oceans changing places, and the climates of the globe shifting like clouds in the sky; whole races and tribes of animal forms disappear and new ones come upon the scene. Such a past! the imagination can barely skirt the edge of it. As the pool in the field is to the sea that wraps the earth, so is the time of our histories to the cycle of ages in which the geologist reckons the events of the earth's history.

Through the eyes of the geologist one may look

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upon his native hills and see them as they were incalculable ages ago, and as they probably will be incalculable ages ahead; those hills, so unchanging during his lifetime, and during a thousand lifetimes, he may see as flitting as the cloud shadows upon the landscape. Out of the dark abyss of geologic time there come stalking the ghosts of lost mountains and lost hills and valleys and plains, or lost rivers and lakes, yea, of lost continents; we see a procession of the phantoms of strange and monstrous beasts, many of them colossal in size and fearful in form, and among the minor forms of this fearful troop of spectres we see the ones that carried safely forward, through the vicissitudes of those ages, the precious impulse that was to eventuate in the human race.

Only the geologist knows the part played by erosion in shaping the earth's surface as we see it. He sees, I repeat, the phantoms of vanished hills and mountains all about us. He sees their shadow forms wherever he looks. He follows out the lines of the flexed or folded strata where they come to the surface, and thus sketches in the air the elevation that has disappeared. In some places he finds that the valleys have become hills and the hills have become valleys, or that the anticlines and synclines, as he calls them, have changed places — as a result of the unequal hardness of the rocks. Over all the older parts of the country the original features have been so changed by erosion that, could they be suddenly

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restored, one would be lost on his home farm. The rocks have melted into soil, as the snow-banks in spring melt into water. The rocks that remain are like fragments of snow or ice that have so far withstood the weather. Geologists tell us that the great Appalachian chain has been in the course of the ages reduced almost to a base level or peneplain, and then reëlevated and its hills and mountains carved out anew.

We change the surface of the earth a little with our engineering, drain a marsh, level a hill, sweep away a forest, or bore a mountain, but what are these compared with the changes that have gone on there before our race was heard of? In my native mountains, the Catskills, all those peaceful pastoral valleys, with their farms and homesteads, lie two or three thousand feet below the original surface of the land. Could the land be restored again to its first condition in Devonian times, probably the fields where I hoed corn and potatoes as a boy would be buried one or two miles beneath the rocks.

The Catskills are residual mountains, or what Agassiz calls "denudation mountains." When we look at them with the eye of the geologist we see the great plateau of tableland of Devonian times out of which they were carved by the slow action of the sub-aerial forces. They are like the little ridges and mounds of soil that remain of your garden-patch after the waters of a cloudburst have swept over it.

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They are immeasurably old, but they do not look it, except to the eye of the geologist. There is nothing decrepit in their appearance, nothing broken, or angular, or gaunt, or rawboned. Their long, easy, flowing lines, their broad, smooth backs, their deep, wide, gently sloping valleys, all help to give them a look of repose and serenity, as if the fret and fever of life were long since passed with them. Compared with the newer mountains of uplift in the West, they are like cattle lying down and ruminating in the field beside alert wild steers with rigid limbs and tossing horns. They sleep and dream with bowed heads upon the landscape. Their great flanks and backs are covered with a deep soil that nourishes a very even growth of beech, birch, and maple forests. Though so old, their tranquillity never seems to have been disturbed; no storm-and-stress period has left its mark upon them. Their strata all lie horizontal just as they were laid down in the old seas, and nothing but the slow gentle passage of the hand of time shows in their contours. Mountains of peace and repose, hills and valleys with the flowing lines of youth, coming down to us from the fore-world of Palæozoic time, yet only rounded and mellowed by the æons they have passed through. Old, oh, so old, but young with verdure and limpid streams, and the pastoral spirit of to-day!

To the geologist most mountains are short-lived. When he finds great sturdy ranges, like the Alps,

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the Andes, the Himalayas, he knows they are young, — mere boys. When they get old, they will be cut down, and their pride and glory gone. A few more of these geologic years and they will be reduced to a peneplain, — only their stumps left. This seems to hold truer of mountains that are wrinkles in the earth's crust — squeezed up and crumpled stratified rock, such as most of the great mountain-systems are — than of mountains of erosion like the Catskills, or of upheaval like the Adirondacks. The crushed and folded and dislocated strata are laid open to the weather as the horizontal strata, and as the upheaved masses of Archæan rock are not. Moreover, strata of unequal hardness are exposed, and this condition favors rapid erosion.

In imagination the geologist is present at the birth of whole mountain-ranges. He sees them gestating in the womb of their mother, the sea. Where our great Appalachian range now stands, he sees, in the great interior sea of Palæozoic time, what he calls a "geosyncline," a vast trough, or cradle, being slowly filled with sediment brought down by the rivers from the adjoining shores. These sediments accumulate to the enormous depth of twenty-five thousand feet, and harden into rock. Then in the course of time they are squeezed together and forced up by the contraction of the earth's crust, and thus the Appalachians are born. When Mother Earth takes a new hitch in her belt, her rocky garment

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takes on new wrinkles. Just why the earth's crust should wrinkle along lines of rock of such enormous thickness is not a little puzzling. But we are told it is because this heavy mass of sediment presses the sea-bottom down till the rocks are fused by the internal heat of the earth and thus a line of weakness is established. In any case the earth's forces act as a whole, and the earth's crust at the thickest points is so comparatively thin — probably not much more than a heavy sheet of cardboard over a six-inch globe — that these forces seem to go their own way regardless of such minor differences.

The Alps and the Himalayas, much younger than our Appalachians, were also begotten and nursed in the cradle of a vast geosyncline in the Tertiary seas. We speak of the birth of a mountain-range in terms of a common human occurrence, or as if it were an event that might be witnessed, measurable in human years or days, whereas it is an event measurable only in geologic periods, and geologic periods are marked off only on the dial-face of eternity. The old Hebrew writer gave but a faint image of it when he said that with the Lord a thousand years are as one day; it is hardly one hour of the slow beat of that clock whose hours mark the periods of the earth's development.

The whole long period during which the race of man has been rushing about, tickling and scratching and gashing the surface of the globe, would make

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but a small fraction of one of the days that make up the periods with which the geologist deals. And the span of human life, how it dwindles to a point in the face of the records of the rocks! Doubtless the birth of some of the mountain-systems of the globe is still going on, and we suspect it not; an elevation of one foot in a century would lift up the Sierra or the Rocky Mountains in a comparatively short geologic period.

II

It was the geologist that emboldened Tennyson to sing, —

“The hills are shadows and they flow
From form to form and nothing stands,
They melt like mists, the solid lands,
Like clouds they shape themselves and go.”

But some hills flow much faster than others. Hills made up of the latest or newest formations seem to take to themselves wings the fastest.

The Archæan hills and mountains, how slowly they melt away! In the Adirondacks, in northern New England, in the Highlands of the Hudson, they still hold their heads high and have something of the vigor of their prime.

The most enduring rocks are the oldest; and the most perishable are, as a rule, the youngest. It takes time to season and harden the rocks, as it does men. Then the earlier rocks seem to have had better stuff in them. They are nearer the paternal granite; and

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the primordial seas that mothered them were, no doubt, richer in the various mineral solutions that knitted and compacted the sedimentary deposits. The Cretaceous formations melt away almost like snow. I fancy that the ocean now, compared with the earlier condition when it must have been so saturated with mineral elements, is like thrice-skimmed milk.

The geologist is not stinted for time. He deals with big figures. It is refreshing to see him dealing out his years so liberally. Do you want a million or two to account for this or that? You shall have it for the asking. He has an enormous balance in the bank of Time, and he draws upon it to suit his purpose. In human history a thousand years is a long time. Ten thousand years wipe out human history completely. Ten thousand more, and we are probably among the rude cave-men or river-drift men. One hundred thousand, and we are — where? Probably among the simian ancestors of man. A million years, and we are probably in Eocene or Miocene times, among the huge and often grotesque mammals, and our ancestor, a little creature, probably of the marsupial kind, is skulking about and hiding from the great carnivorous beasts that would devour him.

“Little man, least of all,
Among the legs of his guardians tall,
Walked about with puzzled look.
Him by the hand dear Nature took,

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Dearest Nature, strong and kind,
Whispered, 'Darling, never mind!
To-morrow they will wear another face,
The founder thou; these are thy race!'"

I fancy Emerson would be surprised and probably displeased at the use I have made of his lines. I remember once hearing him say that his teacher in such matters as I am here touching upon was Agassiz, and not Darwin. Yet did he not write that audacious line about "the worm striving to be man"? And Nature certainly took his "little man" by the hand and led him forward, and on the morrow the rest of the animal creation "wore another face."

III

In my geological studies I have had a good deal of trouble with the sedimentary rocks, trying to trace their genealogy and getting them properly fathered and mothered. I do not think the geologists fully appreciate what a difficult problem the origin of these rocks presents to the lay mind. They bulk so large, while the mass of original crystalline rocks from which they are supposed to have been derived is so small in comparison. In the case of our own continent we have, to begin with, about two million of square miles of Archæan rocks in detached lines and masses, rising here and there above the primordial ocean; a large triangular mass in Canada, and two broken lines of smaller masses running

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south from it on each side of the continent, inclosing a vast interior sea between them. To end with, we have the finished continent of eight million or more square miles, of an average height of two thousand feet above the sea, built up or developed from and around these granite centres very much as the body is built up and around the bones, and of such prodigious weight that some of our later geologists seek to account for the continental submarine shelf that surrounds the continent on the theory that the land has slowly crept out into the sea under the pressure of its own weight. And all this, — to say nothing of the vast amount of rock, in some places a mile or two in thickness, that has been eroded from the land surfaces of the globe in later geological time, and now lies buried in the seas and lakes, — we are told, is the contribution of those detached portions of Archæan rock that first rose above the primordial seas. It is a greater miracle than that of the loaves and the fishes. We have vastly more to end with than we had to begin with. The more the rocks have been destroyed, the more they have increased; the more the waters have devoured them, the more they have multiplied and waxed strong.

Either the geologists have greatly underestimated the amount of Archæan rock above the waters at the start, or else there are factors in the problem that have not been taken into the account. Lyell seems to have appreciated the difficulties of the problem,

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and, to account for the forty thousand feet of sediment deposited in Palæozoic times in the region of the Appalachians, he presupposes a neighboring continent to the east, probably formed of Laurentian rocks, where now rolls the Atlantic. But if such a continent once existed, would not some vestige of it still remain? The fact that no trace of it has been found, it seems to me, invalidates Lyell's theory.

Archæan time in geologic history answers to prehistoric time in human history; all is dark and uncertain, though we are probably safe in assuming that there was more strife and turmoil among the earth-building forces than there has ever been since. The body of unstratified rock within the limits of North America may have been much greater than is supposed, but it seems to me impossible that it could have been anything like as massive as the continent now is. If this had been the case there would have been no great interior sea, and no wide sea-margins in which the sediments of the stratified rocks could have been deposited. More than four fifths of the continent is of secondary origin and shows that vast geologic eras went to the making of it.

It is equally hard to believe that the primary or igneous rocks, where they did appear, were sufficiently elevated to have furnished through erosion the all but incalculable amount of material that went to the making of our vast land areas. But

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the geologists give me the impression that this is what we are to believe.

Chamberlin and Salisbury, in their recent college geology, teach that each new formation implies the destruction of an equivalent amount of older rock — every system being entirely built up out of the older one beneath it. Lyell and Dana teach the same thing. If this were true, could there have been any continental growth at all? Could a city grow by the process of pulling down the old buildings for material to build the new? If the geology is correct, I fail to see how there would be any more land surface to-day than there was in Archæan times. Each new formation would only have replaced the old from which it came. The Silurian would only have made good the waste of the Cambrian, and the Devonian made good the waste of the Silurian, and so on to the top of the series, and in the end we should still have been at the foot of the stairs. That vast interior sea that in Archæan times stretched from the rudimentary Appalachian Mountains to the rudimentary Rocky Mountains, and which is now the heart of the continent, would still have been a part of the primordial ocean. But instead of that, this sea is filled and piled up with sedimentary rocks thousands of feet thick, that have given birth on their surfaces to thousands of square miles of as fertile soil as the earth holds.

That the original crystalline rocks played the

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major part in the genealogy of the subsequent stratified rocks, it would be folly to deny. But it seems to me that chemical and cosmic processes, working through the air and the water, have contributed more than they have been credited with.

It looks as if in all cases when the soil is carried to the sea-bottom as sediment, and again, during the course of ages, consolidated into rocks, the rocks thus formed have exceeded in bulk the rocks that gave them birth. Something analogous to vital growth takes place. It seems as if the original granite centres set the world-building forces at work. They served as nuclei around which the materials gathered. These rocks bred other rocks, and these still others, and yet others, till the framework of the land was fairly established. They were like the pioneer settlers who plant homes here and there in the wilderness, and then in due time all the land is peopled.

The granite is the Adam rock, and through a long line of descent the major part of all the other rocks directly or indirectly may be traced. Thus the granite begot the Algonquin, the Algonquin begot the Cambrian, the Cambrian begot the Silurian, the Silurian begot the Devonian, and so on up through the Carboniferous, the Permian, the Mesozoic rocks, the Tertiary rocks, to the latest Quaternary deposit. But the curious thing about it all is the enormous progeny from so small a beginning; the rocks

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seem really to have grown and multiplied like organic beings; the seed of the granite seems to have fertilized the whole world of waters, and in due time they brought forth this huge family of stratified rocks. There stands the Archæan Adam, his head and chest in Canada, his two unequal legs running, one down the Pacific coast, and one down the Atlantic Coast, and from his loins, we are told, all the progeny of rocks and soils that make up the continent have sprung, one generation succeeding another in regular order. His latest offspring is in the South and Southwest, and in the interior. These are the new countries, geologically speaking, as well as humanly speaking.

The great interior sea, epicontinental, the geologists call it, seems to have been fermenting and laboring for untold æons in building up these parts of the continent. In the older Eastern States we find the sons and grandsons of the old Adam granite; but in the South and West we find his offspring of the twentieth or twenty-fifth generation, and so unlike their forebears; the Permian rocks, for instance, and the Cretaceous rocks, are soft and unenduring, for the most part. The later slates, too, are degenerates, and much of the sandstones have the hearts of prodigals. In the Bad Lands of Arizona I could have cut my way into some of the Eocene formations with my pocket-knife. Apparently the farther away we get from the parent granite, the more easily is

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the rock eroded. Nearly all the wonderful and beautiful sculpturing of the rocks in the West and Southwest is in rocks of comparatively recent date.

Can we say that all the organic matter of our time is from preëxisting organic matter? one organism torn down to build up another? that the beginning of the series was as great as the end? There may have been as much matter in a state of vital organization in Carboniferous or in Cretaceous times as in our own, but there is certainly more now than in early Palæozoic times. Yet every grain of this matter has existed somewhere in some form for all time. Or we might ask if all the wealth of our day is from preëxisting wealth — one fortune pulled down to build up another, — too often the case, it is true, — thus passing the accumulated wealth along from one generation to another. On the contrary, has there not been a steady gain of that we call wealth through the ingenuity and the industry of man directed towards the latent wealth of the earth? In a parallel manner has there been a gain in the bulk of the secondary rocks through the action of the world-building forces directed to the sea, the air, and the preëxisting rocks. Had there been no gain, the fact would suggest the ill luck of a man investing his capital in business and turning it over and over, and having no more money at the end than he had in the beginning.

Nothing is in the sedimentary rock that was not

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at one time in the original granite, or in the primordial seas, or in the primordial atmosphere, or in the heavens above, or in the interior of the earth beneath. We must sweep the heavens, strain the seas, and leach the air, to obtain all this material. Evidently the growth of these rocks has been mainly a chemical process — a chemical organization of preëxisting material, as much so as the growth of a plant or a tree or an animal. The color and texture and volume of each formation differ so radically from those of the one immediately before it as to suggest something more than a mere mechanical derivation of one from the other. New factors, new sources, are implied. “The farther we recede from the present time,” says Lyell, “and the higher the antiquity of the formations which we examine, the greater are the changes which the sedimentary deposits have undergone.” Above all have chemical processes produced changes. This constant passage of the mineral elements of the rocks through the cycle of erosion, sedimentation, and re-induration has exposed them to the action of the air, the light, the sea, and has thus undoubtedly brought about a steady growth in their volume and a constant change in their color and texture. Marl and clay and green sand and salt and gypsum and shale, all have their genesis, all came down to us in some way or in some degree, from the aboriginal crystalline rocks; but what transformations, and

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transmutations they have undergone! They have passed through Nature's laboratory and taken on new forms and characteristics.

"All sediments deposited in the sea," says my geology, "undergo more or less chemical change," and many chemical changes involve notable changes in volume of the mineral matter concerned. It has been estimated that the conversion of granite rock into soil increases its volume eighty-eight per cent, largely as the result of hydration, or the taking up of water in the chemical union. The processes of oxidation and carbonation are also expansive processes. Whether any of this gain in volume is lost in the process of sedimentation and reconsolidation, I do not know. Probably all the elements that water takes from the rocks by solution, it returns to them when the disintegrated parts, in the form of sediment in the sea, is again converted into strata. It is in this cycle of rock disintegration and rock re-formation that the processes of life go on. Without the decay of the rock there could be no life on the land. Water and air are always the go-betweens of the organic and inorganic. After the rains have depleted the rocks of their soluble parts and carried them to the sea, they come back and aid vegetable life to unlock and appropriate other soluble parts, and thus build up the vegetable and, indirectly, the animal world.

That the growth of the continents owes much to the denudation of the sea-bottom, brought about by

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the tides and the ocean-currents, which were probably much more powerful in early than in late geologic times, and to submarine mineral springs and volcanic eruptions of ashes and mud, admits of little doubt. That it owes much to extra-terrestrial sources — to meteorites and meteoric dust — also admits of little doubt.

It seems reasonable that earlier in the history of the evolution of our solar system there should have been much more meteoric matter drifting through the interplanetary spaces than during the later ages, and that a large amount of this matter should have found its way to the earth, in the form either of solids or of gases. Probably much more material has been contributed by volcanic eruptions than there is any evidence of apparent. The amount of mineral matter held in solution by the primordial seas must have been enormous. The amount of rock laid down in Palæozoic times is estimated at fifty thousand feet, and of this thirteen thousand feet were limestone; while the amount laid down in Mesozoic times, for aught we know a period quite as long, amounts to eight thousand feet, indicating, it seems to me, that the deposition of sediment went on much more rapidly in early geologic times. We are nearer the beginning of things. All chemical processes in the earth's crust were probably more rapid. Doubtless the rainfall was more, but the land areas must have been less. The greater amount of carbon dioxide in the air dur-

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ing Palæozoic times would have favored more rapid carbonation. When granite is dissolved by weathering, carbon unites with the potash, the soda, the lime, the magnesia, and the iron, and turns them into carbonates and swells their bulk. The one thing that is passed along from formation to formation unchanged is the quartz sand. Quartz is tough, and the sand we find to-day is practically the same that was dissolved out of the first crystalline rocks.

Take out of the soil and out of the rocks all that they owe to the air, — the oxygen and the carbon, — and how would they dwindle! The limestone rocks would practically disappear.

Probably not less than one fourth of all the sedimentary rocks are limestone, which is of animal origin. How much of the lime of which these rocks were built was leached out of the land-areas, and how much was held in solution by the original seawater, is of course a question. But all the carbon they hold came out of the air. The waters of the primordial ocean were probably highly charged with mineral matter, with various chlorides and sulphates and carbonates, such as the sulphate of soda, the sulphate of lime, the sulphate of magnesia, the chloride of sodium, and the like. The chloride of sodium, or salt, remains, while most of the other compounds have been precipitated through the agency of minute forms of life, and now form parts of the soil and of the stratified rocks beneath it.

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If the original granite is the father of the rocks, the sea is the mother. In her womb they were gestated and formed. Had not this seesaw of land and ocean taken place, there could have been no continental growth. Every time the land took a bath in the sea, it came up enriched and augmented. Each new layer of rocky strata taken on showed a marked change in color and texture. It was a kind of evolution from that which preceded it. Whether the land always went down, or whether the sea at times came up, by reason of some disturbance of the ocean floors in its abysmal depths, we have no means of knowing. In any case, most of the land has taken a sea bath many times, not all taking the plunge at the same time, but different parts going down in successive geologic ages. The original granite upheavals in British America, and in New York and New England, seem never to have taken this plunge, except an area about Lake Superior which geologists say has gone down four or five times. The Laurentian and Adirondack ranges have never been in pickle in the sea since they first saw the light. In most other parts of the continent, the seesaw between the sea and the land has gone on steadily from the first, and has been the chief means of the upbuilding of the land.

To the slow and oft-repeated labor-throes of the sea we owe the continents. But the sea devours her children. Large areas, probably continental in ex-

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tent, have gone down and have not yet come up, if they ever will. The great Mississippi Valley was under water and above water time after time during the Palæozoic period. The last great invasion of the land by the sea, and probably the greatest of all, seems to have been in Cretaceous times, at the end of the Mesozoic period. There were many minor invasions during Tertiary times, but none on so large a scale as this Cretaceous invasion. At this time a large part of North and South America, and of Europe, and parts of Asia and Australia went under the ocean. It was as if the earth had exhaled her breath and let her abdomen fall. The sea united the Gulf of Mexico with the Arctic Ocean, and covered the Prairie and the Gulf States and came up over New Jersey to the foot of the Archæan Highlands. This great marine inundation probably took place several million years ago. It was this visitation of the sea that added the vast chalk beds to England and France. In parts of this country limestone beds five or six thousand feet thick were laid down, as well as extensive chalk beds. The earth seems to have taken another hitch in her girdle during this era. As the land went down, the mountains came up. Most of the great Western mountain-chains were formed during this movement, and the mountains of Mexico were pushed up. The Alps were still under the sea, but the Sierra and the Alleghanies were again lifted.

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It is very interesting to me to know that in Colorado charred wood, and even charcoal, have been found in Cretaceous deposits. The fact seems to give a human touch to that long-gone time. It was, of course, long ages before the evolution of man, as man, had taken place, yet such is the power of association, that those charred sticks instantly call him to mind, as if we had come upon the place of his last campfire. At any rate, it is something to know that man, when he did come, did not have to discover or invent fire, but that this element, which has played such a large part in his development and civilization, was here before him, waiting, like so many other things in nature, to be his servant and friend. As Vulcan was everywhere rampant during this age, throwing out enough lava in India alone to put a lava blanket four or five feet thick over the whole surface of the globe, it was probably this fire that charred the wood. It would be interesting to know if these enormous lava-flows always followed the subsidence of some part of the earth's crust. In Cretaceous times both the subsidence and the lava-flows seem to have been worldwide.

IV

We seem to think that the earth has sown all her wild oats, that her riotous youth is far behind her, and that she is now passing into a serene old age. Had we lived during any of the great periods of the

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past, we might have had the same impression, so tranquil, for the most part, has been the earth's history, so slow and rhythmical have been the beats of the great clock of time. We see this in the homogeneity of the stratified rocks, layer upon layer for thousands of feet as uniform in texture and quality as the goods a modern factory turns out, every yard of it like every other yard. No hitch or break anywhere. The bedding-planes of many kinds of rock occur at as regular intervals as if they had been determined by some kind of machinery. Here, on the formation where I live, there are alternate layers of slate and sandstone, three or four inches thick, for thousands of feet in extent; they succeed each other as regularly as the bricks and mortar in a brick wall, and are quite as homogeneous. What does this mean but that for an incalculable period the processes of erosion and deposition went on as tranquilly as a summer day? There was no strike among the workmen, and no change in the plan of the building, or in the material.

The Silurian limestone, the old red sandstone, the Hamilton flag, the Oneida conglomerate, where I have known them, are as homogeneous as a snow-bank, or as the ice on a mountain lake; grain upon grain, all from the same source in each case, and sifted and sorted by the same agents, and the finished product as uniform in color and quality as the output of some great mill.

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Then, after a vast interval, there comes a break: something like an end and a new beginning, as if one day of creation were finished and a new one begun. The different formations lie unconformably upon each other, which means revolution of some sort. There has been a strike or a riot in the great mill, or it has lain idle for a long period, and when it has resumed, a different product is the result. Something happened between each two layers. What?

Though in remote geological ages the earth-building and earth-shaping forces were undoubtedly more active than they are now, and periods of deformation and upheaval were more frequent, yet had we lived in any of those periods we should probably have found the course of nature, certainly when measured by human generations, as even and tranquil as we find it to-day. The great movements are so slow and gentle, for the most part, that we should not have been aware of them had we been on the spot. Once in a million or a half-million years there may have been terrific earthquakes and volcanic eruptions, such as seem to have taken place in Tertiary time, and at the end of the Palæozoic period. Yet the vast stretches of time between were evidently times of tranquillity.

It is probable that the great glacial winter of Pleistocene times came on as gradually as our own winter, or through a long period of slowly falling temperature, and as it seems to have been many

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hundred thousand times as long, this preceding period, or great fall, was probably equally long — so long that the whole of recorded human history would form but a small fraction of it. It may easily be, I think, that we are now living in the spring of the great cycle of geologic seasons. The great ice-sheet has withdrawn into the Far North like snowbanks that linger in our wood in late spring, where it still covers Greenland as it once covered this country. When the season of summer is reached, some hundreds of thousands of years hence, it may be that tropical life, both animal and vegetable, will again flourish on the shores of the Arctic Ocean, as it did in Tertiary times. And all this change will come about so quietly and so slowly that nobody will suspect it.

That the crust of the earth is becoming more and more stable seems a natural conclusion, but that all folding and shearing and disruption of the strata are at an end, is a conclusion we cannot reach in the face of the theory that the earth is shrinking as it cools.

The earth cools and contracts with almost infinite slowness, and the great crustal changes that take place go on, for the most part, so quietly and gently that we should not suspect them were we present on the spot, and long generations would not suspect them. Elevations have taken place across the beds of rivers without deflecting the course of the river;

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the process was so slow that the river sawed down through the rock as fast as it came up. Nearly all the great cosmic and terrestrial changes and revolutions are veiled from us by this immeasurable lapse of time.

Any prediction about the permanence of the land as we know it, or as the race has known it, or of our immunity from earthquakes or volcanic eruptions, or of a change of climate, or of any cosmic catastrophe, based on human experience, is vain and worthless. What is or has been in man's time is no criterion as to what will be in God's time. The periods of great upheaval and deformation in the earth's crust appear to be separated by millions of years. Away back in pre-Cambrian times, there appear to have been immense periods during which the peace and repose of the globe were as profound as in our own time. Then at the end of Palæozoic time — how many millions of years is only conjectural — the truce of æons was broken, and the dogs of war let loose; it was a period of revolution which resulted in the making of one of our greatest mountain-systems, the Appalachian, and in an unprecedented extinction of species. Later eras have witnessed similar revolutions. Why may they not come again? The shrinking of the cooling globe must still go on, and this shrinking must give rise to surface disturbances and dislocations, maybe in the uplift of new mountain-ranges from the sea-bot-

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tom, now undreamed of, and in volcanic eruptions as great as any in the past. Such a shrinkage and eruption made the Hawaiian Islands, probably in Tertiary times; such a shrinkage may make other islands and other continents before another period of equal time has elapsed.

Of course the periods and eras into which the geologists divide geologic time are as arbitrary as the months and seasons into which we divide our year, and they fade out into each other in much the same way; but they are really as marked as our seasonal divisions. Not in their climates — for the climate of the globe seems to have been uniformly warm from pole to pole, without climatic zones, throughout the vast stretch of Palæozoic and Mesozoic times — but in the succession of animal and vegetable life which they show. The rocks are the cemeteries of the different forms of life that have appeared upon the globe, and here the geologist reads their succession in time, and assigns them to his geologic horizons accordingly. The same or allied forms appeared upon all parts of the earth at approximately the same time, so that he can trace his different formations around the world by the fossils they hold. Each period had its dominant forms. The Silurian was the great age of trilobites; the Devonian, the age of fishes; Mesozoic times swarm with the gigantic reptiles; and in Tertiary times the mammals are dominant. Each period and era

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has its root in that which preceded it. There were rude, half-defined fishes in the Silurian, and probably the beginning of amphibians in the Devonian, and some small mammalian forms in the Mesozoic time, and doubtless rude studies of the genus *Homo* in Tertiary times. Nature works up her higher forms like a human inventor from rude beginnings. Her first models barely suggest her later achievements.

In the vegetable world it has been the same; from the first simple algæ in the Cambrian seas up to the forests of our own times, the gradation is easily traced. Step by step has vegetable life mounted.

The great majority of the plants and animals of one period fail to pass over into the next, just as our spring flowers fail to pass over into summer, and our summer flowers into fall. But the law of evolution is at work, and life always rises on stepping-stones of its dead self to higher things.

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ON the edge of the world my islands lie," sings Mrs. Frear in her little lyric on the Hawaiian Islands.

"On the edge of the world my islands lie,
Under the sun-steeped sky;
And their waving palms
Are bounteous alms
To the soul-spent passer-by.

"On the edge of the world my islands sleep
In a slumber soft and deep.
What should they know
Of a world of woe,
And myriad men that weep?"

On the rim of the world my fancy seemed to see them that May day when we went aboard the huge Pacific steamship in San Francisco Harbor, and she pointed her prow westward toward the vast wilderness of the Pacific — on the edge of the world, looking out and down across the vast water toward Asia and Australia. I wondered if the great iron ship could find them, and if we should realize or visualize the geography or the astronomy when we got there, and see ourselves on the huge rotundity of the globe not far above her equatorial girdle.

Yes, on the rim of the world they lie to the traveler steaming toward them, and on the rim of the

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world they lie in his memory after his return, basking there in that tropical sunlight, forever fanned by those cooling trade winds, and encompassed by that morning-glory sea. With my mind's eye I behold them rising from that enormous abyss of the Pacific, fire-born and rain-carved, vast volcanic mountains miles deep under the sea, and in some cases miles high above it, clothed with verdure and teeming with life, the scene of long-gone cosmic strife and destruction, now the abode of rural and civic peace and plenty.

The Pacific treated me so much better than the Atlantic ever had that I am probably inclined to overestimate everything I saw on the voyage. It was the first trip at sea that ever gave me any pleasure. The huge vessels are in themselves a great comfort, and in the placid waters and the sliding down the rotund side of the great globe under warmer and warmer skies one gains a very agreeable experience. The first day's run must have carried us out and over that huge Pacific abyss, the Tuscarora Deep, where there were nearly four miles of water under us. Some of our aeroplanes have gone up half that distance and disappeared from sight. I fancy that our ship, more than six hundred feet long, would have appeared a very small object, floating across this briny firmament, could one have looked up at it from the bottom of that sea.

The Hawaiian Islands rise from the border of that

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vast deep, and one can fancy how that huge pot must have boiled back in Tertiary times, when the red-hot lava of which they are mainly built up was poured from the interior of the globe.

Softer and more balmy grew the air every day, more and more placid and richly tinted grew the sea, till, on the morning of the sixth day, we saw ahead of us, low on the horizon, the dim outlines of the mountains of Molokai. The island of Oahu, upon which Honolulu is situated, was soon in sight. It was not long before we saw Diamond Head, a vast crater bowl, eight hundred feet high on its ocean side, and half a mile across, sitting there upon the shore like some huge, strange work of man's hand, running back through the hills with a level rim, and seaward with a sloping base, brown and ribbed, and in every way unique and striking.

We were approaching a land the child of tropic seas and volcanic lava, and many of the features were new and strange to us. The mountains looked familiar in outline, but the colors of the landscape, the soft lilacs, greens, and browns, and the whole atmosphere of the scene, were unlike anything we had ever before seen. And Diamond Head, what a feature it was! Had it only had a head, one could easily have seen in it a suggestion of a couchant lion, bony, huge, and tawny, looking seaward, and guarding the harbor of Honolulu which lies just behind it. Into this harbor, in the soft morning air,

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our ship soon found its way, and the monotony of the vast, unpeopled sea was quickly succeeded by human scenes of the most varied and animated character, not the least novel of which were the swarms of half-amphibious native boys who surrounded the vessel as she lay at the wharf, and with brown, upturned faces and beckoning hands tempted the passengers to toss dimes into the water. As the coins struck the surface they would dive with the ease and quickness of seals, and seize the silver apparently before it had gone a yard toward the bottom. Holding the coins up to view between the thumb and finger, they would slip them into their mouths and solicit more.

On shore we were greeted with the music of the Royal Hawaiian Band, and a motley crowd of Hawaiians, Japanese, Chinese, Portuguese, and Americans, bearing colored *leis*, or wreaths of flowers, which they waved at friends on board, and with which they bedecked them as soon as they came off the gangplank. It was a Babel of tongues in which the strange, vowel-choked language of the Hawaiians was conspicuous.

Honolulu is a beautiful city, clean, bright, well ordered, and well appointed,—electric lights, good streets, electric cars, fine hotels and clubs, excellent fire protection, mountain water, libraries, parks, handsome buildings, attractive homes,—in fact, all that we boast of in our home cities. Embosomed in

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palms, with mangoes, and other tropical trees, with a profusion of gorgeously colored vines and hedges, with spacious, well-kept grounds about the large and comfortable houses in the residential portion — these features, with the ready hospitality of the people, made our hearts warm towards it at once.

Volcanic heights on all the land side look down upon the city. Mount Tantalus, rising four thousand feet above the sea, is just back of it, with its long slopes of volcanic ash and sand now clothed by forests and fertile fields, and a huge ancient crater called the Punch Bowl, born probably on the self-same day, the geologists think, as Diamond Head, dominates the city in the immediate foreground. If the Punch Bowl were again to overflow with the fiery liquid, the city would soon go up in smoke. But its bowl-like interior is now covered with grass and trees, and presents a scene of the most peaceful, rural character.

The Orient and the Occident meet in Honolulu. There Asia and America join hands. The main features of the city are decidedly American, but the people seen upon the street and at work indoors and out are more than half Oriental. The native population cuts only a small figure. The real workers — carpenters, masons, field hands, and house servants — are mostly Japanese. Virtually all the work of the immense sugar plantations is done by the little brown men and women, while China sup-

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plies some of the merchants in the city and the sailors and stewards on the ocean steamers. What admirable servants the Chinese make, so respectful, so prompt, so silent, so quick to comprehend! The Japanese house servants on the islands also give efficient and gracious service.

I had gone to Honolulu reluctantly, but tarried there joyfully. The fine climate, with its even temperature of about eighty degrees Fahrenheit, and with all that is enervating or oppressive in that degree of heat winnowed out of it by the ceaseless trade winds; the almost unbroken sunshine, perfumed now and then by a sprinkle of sunlit rain from the mountains; the wonderful sea laving the shores on the one hand and the cool, cloud-capped, and rain-drenched heights within easy reach on the other; the green, cozy valleys; the broad sweep of plain; the new, strange nature on every side; the novel and delicious fruits; the pepsin-charged papaya, or tree melon, which tickles the palate while it heals and renews the whole digestive system; the mangoes (oh, the mangoes!); the cordiality of the people; the inviting bungalows; the clean streets; the good service everywhere — all made me feel how mistaken was my reluctance.

Most of the Americans one meets there are descendants of the missionaries who went out from New England and New York early in the last century, and one feels at home with them at once.

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Many of the residents there have been educated in the States. The Governor, Mr. Frear, is a graduate of Yale; his wife is a graduate of Wellesley. One day a charming Southern woman, president of the College Club, invited us to meet the college women of the city. The gathering took place under the trees upon the lawn of one of the older homesteads. There were forty college women present, many of them teachers, from Vassar, Wellesley, Smith, Bryn Mawr, and Barnard. Among them were two girls who had visited me at my cabin, "Slabsides," while they were at Vassar.

Wide as is the world, the traveler is pretty sure to strike threads of relation with his home country wherever he goes. I made the acquaintance in Honolulu of a man from my own county; another, who showed us great kindness, was from an adjoining county; while one day upon the street I was called by name by a man whom I had known as a boy in the town where I now live.

One Saturday a walking-club, largely made up of men and women teachers, whose native Hawaiian name meant "Walkers in Unfrequented Places," asked us to join them in a walk up Palola Valley to the site of an extinct crater well up in the mountains. These walkers in unfrequented places proved to be real walkers, and gave us all and more than we had bargained for — more mud and wet and slippery trails through clinging vines and rank lantana

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scrub than was good for our shoes and garments or for the bodies inside them. It was a long pull of many miles, at first up the valley over a fair highway, then into the woods on the mountain-side along a trail that was muddy and slippery from the recent showers, and most of the time was buried out of sight beneath the high, coarse stag-horn fern and a thick growth of lantana that met above it as high as our shoulders. A more discouraging mountain climb I never undertook. The vegetation was all novel, but it had that barbaric rankness of all tropical woods, with nothing of the sylvan sweetness and simplicity of our home woods. There were no fine, towering trees, but low, gnarled, and tortuous ones, which, with their hanging vines, like the broken ropes of a ship's rigging, and their parasitic growths, presented a riotous, disheveled appearance.

Nature in the tropics, left to herself, is harsh, aggressive, savage; looks as though she wanted to hang you with her dangling ropes, or impale you on her thorns, or engulf you in her ranks of gigantic ferns. Her mood is never as placid and sane as in the North. There is a tree in the Hawaiian woods that suggests a tree gone mad. It is called the hau-tree. It lies down, squirms, and wriggles all over the ground like a wounded snake; it gets up, and then takes to earth again. Now it wants to be a vine, now it wants to be a tree. It throws somersaults, it makes itself into loops and rings, it rolls,

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it reaches, it doubles upon itself. Altogether it is the craziest vegetable growth I ever saw. Where you can get it up off the ground and let it perform its antics on a broad skeleton framework, it makes a cover that no sunbeam can penetrate, and forms a living roof to the most charming verandas — or *lanais*, as they are called in the islands — that one can wish to see.

But I saw and heard one thing on this walk that struck a different note: it was one of the native birds, the Oahu thrush. The moment I heard it I was reminded of our brown thrasher, though the song, or whistle, was much finer and richer in tone than that of our bird. The glimpse I got of the bird showed it to be of about the size and shape of our thrasher, but much brighter in color. It seems as though the two species must have had a common origin some time, somewhere. I was attracted by no other native bird on this walk. In the valley below we had seen and heard the Chinese workmen going about their rice-fields making strange sounds to drive away the rice-birds, a small, brown species that has been introduced from India.

When we reached the mountain-top, we found it enveloped in fog and mist, and the scene was cold and cheerless. We looked down through a screen of foliage into a deep valley that seemed almost beneath us, and which is supposed to have been an ancient crater. There, on the brink, the walkers had

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a rude cabin, where we ate our lunch beside a fire and tried to dry our bedraggled garments.

From this point some of the party continued their walk, looking for more unfrequented places, but some of us had longings the other way, and retraced our steps toward the sunlight and the drier winds we had left. We reached town footsore and bedraggled, and the little Japanese who cleaned and pressed my suit of clothes, and made them look as good as new for seventy-five cents, well earned his money.

The walk of eight or ten miles which we took two weeks later with Governor Frear and his wife, up the new Castle trail to the mountain-top behind Tantalus, had some features in common with the first walk, — the increasing mist and coolness as we entered the mountains, the dripping bushes, and the slippery paths, — but we got finer views, and found a better-kept trail. Our walk ended on the top of a narrow ridge of the mountain, where we ate our lunch in a cold, driving mist and were a bit uncomfortable. I was interested in the character of the ridge upon which we sat. It was not more than six feet wide, a screen of volcanic rock worn almost to an edge, and separated two valleys six or seven hundred feet deep. The Governor said he could take me where the dividing ridge between the two valleys was so narrow that one could literally sit astride of it, so that one leg would point to one valley and the

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other to the other. This is a feature of a new country geologically; the rains and other agents of erosion have whittled the mountains to sharp edges, but have not yet rounded or leveled them.

The northeast trade winds which blow upon these islands nine months in the year bring a burden of moisture from the Pacific which is condensed into rain and mist by the mountains, and which, with the rank vegetation that it fosters, carves them and sharpens them like a great grindstone revolving against their sides. At a place called the Pali — and at the Needles, on the island of Maui — it has worn through the mountain-chain and made deep and very picturesque gorges where, in the case of the Pali, the wind is so strong and steady that you can almost lie down upon it.

It was near the Pali that I saw what I had never seen or heard of before — a waterfall reversed, going up instead of down. It suggested Stockton's story of negative gravity. A small brook comes down off the mountain and attempts to make the leap down a high precipice; but the winds catch it and carry it straight up in the air like smoke. It is translated; it becomes a mere wraith hovering above the beetling crag. Night and day this goes on, the wind snatching from the mountains in this summary way the water it has brought them.

On the walk with the Governor we made the acquaintance of some of the land shells for which these

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islands are famous — pretty, pearl-like little whorls living on the largest trees, and about the size of a chipping sparrow's egg, with pointed ends, variously colored. There are more than two hundred species on the different islands, I think, each valley having varieties peculiar to itself, showing what a factor isolation is in the evolution of new species. The Governor and his wife, and a young man who had specialized in conchology, plucked them from nearly every bush and tree; but my eye, being untrained in this kind of work, was very slow in finding them.

Coming down from these Hawaiian mountains is like coming out of a dripping tent of clouds into the clear, warm sunshine. The change is most delightful. Your clothing dries very quickly, and chilliness gives place to genial warmth. And the prospects that open before you, the glimpses down into these deep, yellow-green, crater-like valleys, checkered with neat little Chinese farms, the panorama of the city and the sea unrolling as you come down, and always Diamond Head standing guard there to the east — how the vision of it all lingers in the memory!

In climbing the heights, it was always a surprise to me to see the Pacific rise up as I rose, till it stood up like a great blue wall there against the horizon. A level plain unrolls in the same way as we mount above it, but it does not produce the same illusion

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of rising up like a wall or a mountain-range ; the blue, facile water cheats the eye.

One of the novel pleasures in which most travelers indulge while in Honolulu is surf-riding at Waikiki, near Diamond Head. The sea, with a floor of lava and coral, is here shallow for a long distance out, and the surf comes in at intervals like a line of steeds cantering over a plain. We went out in our bathing-suits in a long, heavy dugout, with a lusty native oarsman in each end. When several hundred yards from shore, we saw, on looking seaward, the long, shining billows coming, whereupon our oarsmen headed the canoe toward shore, and plied their paddles with utmost vigor, uttering simultaneously a curious, excited cry. In a moment the breaker caught us and, in some way holding us on its crest, shot us toward the shore like an arrow. The sensation is novel and thrilling. The foam flies; the waters leap about you. You are coasting on the sea, and you shout with delight and pray for the sensation to continue. But it is quickly over. The hurrying breaker slips from under you, and leaves you in the trough, while it goes foaming on the shore. Then you turn about and row out from the shore again, and wait for another chance to be shot toward the land on the foaming crest of a great Pacific wave.

I suppose the trick is in the skill of the oarsmen in holding the boat on the pitch of the billow so that in its rush it takes you with it. The native

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boys do the feat standing on a plank. I was tempted to try this myself, but of course made a comical failure.

One of my pleasant surprises in Honolulu — one that gave the touch of nature which made me feel less a stranger there — was learning that the European skylark had been introduced and was thriving on the grassy slopes back of the city. The mina, a species of starling from India as large as our robin and rather showily dressed, with a loud, strident voice, I had seen and heard everywhere both in town and country, but he was a stranger and did not appeal to me. But the thought of the skylark brought Shelley and Wordsworth, and English downs and meadows, near to me at once, and I was eager to hear it. So early one morning we left the Pleasanton, our tarrying-place, and climbed the long, pastoral slope above the city, where cattle and horses were grazing, and listened for this minstrel from the motherland. We had not long to wait. Sure enough, not far from us there sprang from the turf Shelley's bird, and went climbing his invisible spiral toward the sky, pouring out those hurried, ecstatic notes, just as I had heard him above the South Downs of England. It was a moment of keen delight to me. The bird soared and hovered, drifting about, as it were, before the impetuous current of his song, with all the joy and abandon with which the poets have credited him. It was like a bit of

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English literature vocal in the air there above these alien scenes. Presently another went up, and then another, and still another, the singers behaving in every respect as they do by the Avon and the Tweed, and for a moment I seemed to be breathing the air that Wordsworth and Shelley breathed.

If our excursion had taken us only to the island of Oahu and its beautiful city, it would have been eminently worth while, but the last week in May we took what is called the inter-island trip, a six days' voyage among the various islands, when we visited the great extinct crater of Haleakala on Maui, and the active volcano Kilauea on Hawaii. It is a voyage over several rough channels in a small steamer, and my friends said, "If you have not yet paid tribute to Neptune, you will pay it now." But I did not. My companions were prostrated, but I see Neptune respects age, and my slumbers were undisturbed. A wireless message had gone to Mr. Aiken, on the island of Maui, to meet us with his automobile in the morning at the landing at Kahului. We were taken to the shore on a lighter, along with the horses and cargo, and there found our new friend awaiting us.

The great mountain of Haleakala rose up in a long line against the sky on the left, and the deeply eroded and cañoned mountains of the older, or west, end of the island on our right. Toward the latter our guide took us. It was a pleasant spin along the good

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roads, in the fresh morning air, near the beach, to Wailuku, the shire town of the island, two or three miles distant. Here we were most hospitably entertained in the home of Mr. Penhallow, the director of a large sugar plantation.

Here for the first time in my life I saw a gang of steam plows working, pulled by a stationary engine at each end of the field, and turning over the red, heavy volcanic soil. The work was mainly in the hands of Japanese, and was well done. We afterward saw Japanese by the score, both men and women, planting a large area of newly plowed land with sugar-cane.

After we were rested and refreshed, and had sampled the mangoes that had fallen from a tree near the house, Mr. Aiken took us in his automobile up into the famous Iao Valley, at the mouth of which Wailuku is situated. It is a deep, striking chasm carved out of the mountain by the stream, rank with verdure of various kinds, and looked down upon by sharp peaks and ridges five or six thousand feet high. We soon reached the clear rapid, brawling stream, as bright as a Catskill mountain trout brook, and after a mile or two along its course we came to the end of the road, where we left the machine and took a trail that wound onward and upward over a slippery surface and through dripping bushes, for we here began to reach the skirts of the little showers that almost constantly career over and

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about the interior of these mountains. I neither saw nor heard a bird or other live thing. Guava apples lay on the ground all along the trail, and one could eat them and not make faces. Some of the sharp, knife-blade ridges that cut down toward us from the higher peaks were very startling, and so steep and high that they could be successfully scaled only by the aid of ropes and ladders. A more striking object-lesson in erosion by rain would be hard to find. There were no naked rocks; short, thick vegetation covered even the steepest slopes, and the vegetable acids which this generated, and the perpetual rains, weathered the mountains down. It soon became so wet that we stopped far short of the head of the valley, and turned back. I wished to look into the great, deep, green amphitheatre which seems to lie at the head, but had glimpses of it only from a distance. How many millenniums will it be, I said to myself, before erosion will have completed its work here, and these thin, high mountain-walls will be in ruins? Surely not many.

We returned to the hospitable home we had left, and passed the midday there. In the afternoon Mr. Aiken, guiding our eyes by the forms of trees that cut the horizon-line on the huge flank of Haleakala, pointed out the place of his own homestead, twenty or more miles away. From this point the great mountain appeared like a vast landscape tilted up at an easy angle against the horizon. One could

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hardly believe it was ten thousand feet high. The machine climbed easily more than half the distance to Mr. Aiken's plantation, which we reached in good time in the afternoon, and where we passed a very enjoyable night. It was a surprise to find swarms of mosquitoes at this altitude, so free from all mosquito-breeding waters. But the house was well protected against them. Mosquitoes, as well as flies and vermin, are not native to the island. They came in ships not very long ago, and are now very troublesome in certain parts. They came round the Horn. Mr. Aiken's house itself came round the Horn seventy or eighty years ago. It is a quaint, New England type of house, and has a very homelike look. In front of it, near the gate, stands a Japanese pine which is an object of veneration to all Japanese who chance to come that way. Often their eyes fill with tears on beholding it, so responsive are the little yellow men to associations of home.

In the morning Mr. Aiken drove us in a wagon to a place he has called "Idlewild," six miles farther up the great slope of the mountain. This slope of Haleakala is like a whole township, diversified with farms and woods, valleys and hills, resting on its elbows, so to speak, and looking out over the Pacific. We could look up to the cloud-line, about seven thousand feet above the sea, and occasionally get a glimpse of the long line of the summit through rifts

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in the clouds. At Idlewild our expedition, consisting of six mules and four people, was fitted out, and in the early afternoon we started on the trail up the mountain.

For several miles our way led over grassy slopes where cattle were grazing, and above which sky-larks were singing. This was one of the happy surprises of the trip — the soaring and singing sky-larks. All the way till we reached the cloud-belt, we had the larks pouring down their music from the sky above us. They seemed specially jubilant. It was May in England, too, and they sang as though the spirit of those downs and fells was stirring in their hearts, under alien skies, but true to the memories of home.

Before we reached the summit we came upon another introduction from overseas — the English pheasant. One started up from some bushes only a few yards from the trail, went booming away, and disappeared in a deep gully. A little later another sprang up, uttering a cackling cry as it flew away. We saw three altogether. The only home thing we saw was white clover in patches here and there, and it gave a most welcome touch to the unfamiliar scenes.

The cattle we passed on the way were suffering dreadfully from another introduction from the States — the Texas horn-fly, which had recently made its appearance. The poor beasts were driven half-

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crazy by it, as their sunken eyes and poor condition plainly showed.

The trail became rougher and steeper as we ascended, and the grass and trees gave place to low, scrubby bushes. We were half an hour or more in the cloud-belt, where the singing skylarks did not follow us. The clouds proved to be as loose of texture and as innocent as any summer fog that loiters in our valleys; but it was good to emerge into the sunshine again, and see the jagged line of the top sensibly nearer, and the canopy of clouds unroll itself beneath us. Far ahead of us and near the summit we saw a band of wild goats — twenty-two, I counted — leisurely grazing along, and now and then casting glances down upon us. They were domestic animals gone wild, and still retained their bizarre colors of white and black. One big black leader with a long beard looked down at us and shook his head threateningly. We reached the summit before the sun reached the horizon, and our eyes looked forth upon a strange world, indeed. On one hand the vast sea of cloud, into which the sun was about to drop, rolled away from the mountain below us, with its white surface and the irregular masses rising up from it, suggesting a sea of floating ice. Through rifts in it we caught occasional glimpses of the Pacific — blue, vague, mystical gulfs that seemed filled with something less substantial than water. On the other hand was the vast crater

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of Haleakala, two thousand feet deep, and many miles across, in which the shadows were deepening, and which looked like some burned-out Hades.

We stood or sat on the jagged edge and saw the day depart and the night come down, the glory of cloud and sea and sunset on the one hand, and on the other side the fearful chasm of the extinct volcano, red and black and barren, with the hosts of darkness gathering in it. It was like a seat between heaven and hell. Then later, when the Southern Cross came out and rose above the awful gulf, the scene was most impressive.

The crater of Haleakala is said to be the largest extinct crater in the world. To follow all its outlines would lead one a distance of more than twenty miles, but it is so irregular in shape that one gets only a poor conception of its extent in a view from its brink. At its widest part it cannot be more than four or five miles across. It was evidently formed by the whole top of the mountain having been blown out or else sunk down in recent geologic times. The fragments of jagged rock that thickly strew the surface all about the summit look as if they might have fallen there. The floor of the interior of the crater is thickly studded with many minor craters, through which the internal fires found vent after the crater as a whole had ceased to act. They are of the shape of huge haystacks, with a hole in the top, and looked soft and yielding in outline, and in color as though

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they were composed of soot and brick-dust. One of them is much larger than any of the rest. I thought it might be two hundred feet high. "It is eight hundred," said our guide; yet its summit was more than a thousand feet below the rim upon which we sat.

There has been no eruption in Haleakala since early in the last century. Over a large area of the interior the black lava, cracked and crumpled, meets the eye. Miles down one of its great arms toward the sea, we could see the green lines of vegetation, mostly rank ferns, advancing like an invading army. Far ahead were the skirmishers, loose bands of ferns, with individual plants here and there pushing on over the black, uneven surface toward the secondary craters of the centre. Vegetation was also climbing down the ragged sides of the crater, dropping from rock to rock like an invading host. The ferns, those pioneers of the vegetable world, appear to come first. Their giant progenitors subdued the rocks and made the soil in Carboniferous times, and prepared the way for higher vegetable forms, and now these striplings take up the same task in this primitive world of the crater of Haleakala. Their task is a long and arduous one, much more so than in those parts of the island where the rainfall is more copious; but give them time enough, and the barren lava will all be clothed with verdure. When decomposed and ripened by time, it makes a red, heavy soil that supports many kinds of plants and trees.

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The ferns come slowly marching in from without, but in the centre of the crater, on the slopes of the red cones and at their bases, is another plant that seems indigenous, born of the ash and the scoria of the volcano, and that apparently has no chlorophyll in its make-up. This is a striking plant, called the silver sword, from the shape and color of its long, narrow leaves. They are the color of frosted silver, and are curved like a sword. It is a strange apparition, white and delicate and rare, springing up in the crater of a slumbering volcano. A more striking contrast with the atmosphere of the surroundings would be hard to find — a suggestion of peace and purity above the graves of world-destroying forces, an angel of light nourished by the ashes of the demons of death and darkness.

It is claimed by the people of the island that this plant is found in no other place on the globe, but this can hardly be possible. If its evolution took place in one crater, it would take place in another. It consists of a great mass of silvery-white, bristling leaves resting upon the ground, from which rises a stalk, strung with flowers, to the height of five or six feet. It is evidently of the *Yucca* type of plant, and has met with a singular transformation in the sleeping volcano's mouth, all its harsh and savage character turned into gentleness and grace, its armament of needles and daggers giving place to a soft, silvery down. We did not see the plant grow-

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ing except at a great distance, through field-glasses, but we saw a photograph of it and a dried specimen after we came down from the summit.

It is an all day's trip down into the crater and back, climbing over sliding sands and loose scoria, and our time was too limited to undertake it. We passed the night on the summit in a rude stone hut, which had a fireplace where the guide made coffee, but we had only the volcanic rock for floor. Upon this we spread our ample supply of blankets, and got such sleep as is to be had on high, cold mountain-tops, where the ribs of the mountain prove to be so much harder than one's own ribs — not a first-class quality of sleep, but better than none.

I arose about two o'clock, and made my way out into the star-blazing night. Such glory of the heavens I had never before seen. I had never before been lifted up so near them, and hence had never before seen them through so rarefied an atmosphere. The clouds and vapors had disappeared, and all the hosts of heaven were magnified. The Milky Way seemed newly paved and swept. There was no wind and no sound. The mighty crater was a gulf of blackness, but the sky blazed with light.

The dawn comes early on such a mountain-top, and before four o'clock we were out under the fading stars. As we had seen the day pass into night, surrounded by these wonderful scenes, now we saw

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the night pass into day, and the elemental grandeur on every hand reborn before us. There was not a wisp of cloud or fog below us or about us to blur the great picture. The sun came up from behind the vast, long, high wall of the Pacific that filled the eastern horizon, and the shadows fled from the huge pile of mountain in the west. We hung about the rim of the great crater or sat upon the jagged rocks, wrapped in our blankets, till the sun was an hour high.

We got another glimpse of the band of goats picking their way from ledge to ledge far below us on the side of the crater. I saw and heard two or three mina birds fly past, apparently seeking new territory to occupy. These birds are more enterprising than the English sparrows, which also swarm in the island towns but do not brave the mountain-heights. The bird from India seems at home everywhere.

After breakfast we still haunted for an hour or more the brink of the great abyss, where one seemed to feel the pulse of primal time, loath to tear ourselves away, loath also to take a last view of the panorama of land and sea, lit by the morning sun, which spread out far below us. To the southeast we could dimly see the outlines of the island of Hawaii, with a faint gleam of snow on its great mountain Mauna Loa, nearly fourteen thousand feet high. In the northwest a dim, dark mass low

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in the horizon marked the place of Oahu. The ocean rose in the vast horizon and blended with the sky. The eye could not tell where one ended and the other began.

The mules had had a comfortable night in a rude stone stable against the rocks, and were more eager to hit the down trail than were we. The descent proved more fatiguing than the ascent, the constant plunging motion of the animals' shoulders being a sore trial. We dropped down through the belt of clouds that had begun to form, and out into the grassy region of the singing skylarks, past herds of grazing cattle, and at noon were again at Idlewild, resting our weary limbs and comforting the inner man.

In the afternoon Mr. Aiken drove us back to his home farm, where we again passed a very pleasant night. In the morning I walked with him through his pineapple plantation. It was a new kind of farming and fruit-growing to me. I forget now how many hundred thousand plants his field contained. They are set and cultivated much as cabbage is with us, but present a strangely stiff and forbidding aspect. The first cutting is when the plants are about eighteen months old, one large solid apple from each plant. The second crop is called the "raggoon" crop, and yields two apples from each plant, but smaller and less valuable than the first. The field is then reset. I also walked with Mr.

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Aiken over some new land he was getting ready for pineapples. It had been densely covered with lantana scrub, and clearing it and grubbing it out had been an heroic task. The lantana takes complete possession of the soil, grows about four or five feet high, and makes a network of roots in the soil that defies anything but a steam plow. The soil is a red, heavy clay, and it made the farmer in me sweat to think of the expenditure of labor necessary to turn a lantana bush into a pineapple field. The redness of this volcanic soil is said to be owing to the fact that the growth of vegetation brings the iron into new combinations with organic acids.

Later in the day we visited the large Baldwin pineapple-canning plant, and were shown the whole process of preparing and canning the fruit, and all but surfeited with the most melting and delicious pineapples it was ever my good luck to taste. The Hawaiian pineapple probably surpasses all others in tenderness and lusciousness, and it loses scarcely any of these qualities in the cans. Ripened in the field, where it grew on the flanks of great Haleakala, and eaten out of hand, it is a dream of tropic lusciousness. The canning is done by an elaborate system of machinery managed by Japanese men and women, the naked hand never coming in contact with the peeled fruit, but protected from it by long, thin rubber gloves. There ought to be a great future for this industry, when Eastern con-

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sumers really find out the superior quality of the Hawaiian product.

From Mr. Aiken's house one has a view of the great wall of mountains that form the western and older — older geologically — end of the island, in which lies the famous Iao Valley, which I have already described. We judge, from the much deeper marks of rain erosion, that this end of the island is vastly older than the butt end upon which Haleakala is situated. Haleakala is eroded comparatively little. On all its huge northern slope there is only one considerable gash or gully, and this is probably not many thousand years old; but the northwestern end of the island is worn and carved in the most striking manner. Looking at it that morning, I compared it to my extended, relaxed hand, the northern end being gashed and grooved like the sunken spaces between the fingers, while the southwest end, not more than ten miles distant, was only slightly grooved and more like the solid wrist and back hand. All the rains brought by the northeast trades fall upon the northeast end of the islands. The mountain-peaks on the end hold the clouds and strip them dry, so that little or no rain falls upon the south and southwest sides. This is true of all the islands. One end of each is arid and barren, while the other is wet and verdant. One of the smaller islands, Kahoolawe, I believe, dominated by Maui on the northeast, is said to be drying up and blowing away by inches.

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What a spell the mountains do lay upon the clouds everywhere, — the robber mountains, — in these islands exacting the last drop of water of all the ocean-born vapors that pass over them! On the northeast side of the Lahaina district there are valleys four or five thousand feet deep; on the southwest side there are no valleys worth mentioning. The difference in this respect was forcibly brought home to me when, later in the day, we made an automobile trip from Wailuku to Lahaina on the southwest side; in going less than twenty miles we quickly passed from the region of verdant valleys and mountain-slopes into a hard, raw, barren, unweathered region, where there was no soil, and where the rocks looked as crude and forbidding as they must have looked the day they flowed out from the depths as molten lava. In outline the island of Maui suggests a truncated statue, the west end representing the head, very old and wrinkled and grooved by time and trouble, the peninsula the well-proportioned neck, and broad-breasted Haleakala forming the trunk. What a torso it is, fire-born and basking there in the tropic seas!

The oldest island of the Hawaiian group is Kauai, called the garden island, because it has much the deepest and most fertile soil. It shows much more evidence of erosion than any of the other islands. The next in point of erosion, and hence in point of age, is Oahu, upon which Honolulu is situated.

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Then come Molokai and Maui, the two ends of the latter being of vastly unequal age. Hawaii, the largest of them all, nearly as large as Connecticut, is the youngest of the group, and shows the least effects of erosion. When it is as old as Kauai is now, its two huge mountains, Mauna Loa and Mauna Kea, will probably be cut up into deep valleys and cañons and sharp, high ridges, as are the mountains of Kauai and Oahu. The lapse of time required to bring about such a result is beyond all human calculation. Whether one million or two millions of years would do it, who knows? Those warm tropical rains, aided by the rank vegetation which they beget and support, dissolve the volcanic rock slowly but inevitably.

Through the courtesy of Mr. Lowell, the superintendent, we had that day the pleasure of going through a large sugar-making plant at Paia — one that turns out nearly fifty thousand tons of sugar a year. We saw the cane come in from the fields in one end of the plant, and the dry, warm product being put up in bags at the other. All the latest devices and machinery for sugar-making we saw here in full operation, affording a contrast to the crude and wasteful methods I had seen in the island of Jamaica a few years before.

In the afternoon we availed ourselves of the five or six miles of narrow-gauge railway, the only one on the island, to go from Paia to Wailuku, where we

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were met by another automobile, which hurried us to Lahaina, where we were to meet the steamer that was to convey us to Hilo, on Hawaii. I say "hurried," but before the journey of twenty-odd miles was half over, we realized the truth of the old adage, "The more haste, the less speed." The automobile began to sulk and finally could be persuaded to go only on the low gear, and to rattle along at about the speed of a man with a horse and buggy. We reached Lahaina just as the boat was entering the harbor.

The next morning we found ourselves steaming along past the high, verdant shores of Hawaii. For fifty miles or more the land presented one unbroken expanse of sugar-cane, suggesting fields of some gigantic yellow-green grass. At Hilo the sun was shining between brief showers, and the air was warm and muggy. It is said to rain there every day in the year, and the lush vegetation made the statement seem credible. Judge Andrews met us at the steamer, and took us to his home for rest and dinner, and was extremely kind to us.

In the mid-afternoon we took the train for Glenwood, thirty miles on our way to the volcano of Kilauea. A large part of the way the road leads through sugar plantations, newly carved out of the koa and tree-fern wilderness that originally covered the volcanic soil. Clusters of the little houses of the Japanese laborers, perched high above the ground

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on slender posts, were passed here and there. Everywhere we saw wooden aqueducts, or flumes, winding around the contours of the hills and across the little valleys, often on high trestle-work, and partly filled with clear, swift-running water, in which the sugar-cane was transported to the mills.

At Glenwood stages meet the tourists and convey them over a fairly good road that winds through the tree-fern forests to the Volcano House, ten miles away. The beauty of that fern-lined forest, the long, stately plumes of the gigantic ferns meeting the eye everywhere, I shall not soon forget. I saw what appeared to be a large, showy red raspberry growing by the roadside, but I did not find it at all tempting to the taste.

It was dark when we reached the Volcano House, and we saw off to the left a red glow upon the fog-clouds, like the reflected light from a burning barn or house in the country, and inferred at once that it came from the volcano, which it did. From my window that night, as I lay in bed, I could see this same angry glow upon the clouds. The smell of sulphur was in the air about the hotel, and very hot steam was issuing from cracks in the rocks. A party of tourists on horseback, in the spirit of true American hurry, visited the volcano that night, but we chose to wait until the morrow.

The next morning the great crater of Kilauea was filled with fog, but it lifted, and the sun shone be-

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fore noon. We passed a pleasant forenoon strolling along the tree-fringed brink, looking down eight or nine hundred feet upon its black lava floor, and plucking ohelo berries, which grew there abundantly, a kind of large, red huckleberry that one could eat out of hand, but that one could not get excited over. They were better in a pie than in the hand. Their name seemed to go well with the suggestion of the scenes amid which they grew. Kilauea is a round extinct crater about three miles across and seven or eight hundred feet deep. It has been the scene of terrific explosions in past ages, but it has now dwindled to the small active crater of Halemaumau, which is sunk near the middle of it like a huge pot, two hundred or more feet deep and a thousand feet across.

In the mid-afternoon a party of eight or ten of us on horseback set out to visit the volcano. The trail led down the broken and shelving side of the crater, amid trees and bushes, till it struck the floor of lava at the bottom. In going down I was aware all the time of a beautiful bird-song off on my left, a song almost as sweet as that of our hermit thrush, but of an entirely different order. I think it was the song of one of the honey-suckers, a red bird with black wings that in flight looked like our scarlet tanager.

Our course took us out over the cracked and contorted lava-beds, where no green thing was growing. The forms of the lava-flow suggested mailed and

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writhing dragons, with horrid, gaping mouths and vicious claws. The lava crunched beneath the horses' feet like shelly and brittle ice. At one point we passed over a wide, jagged crack on a bridge. As we neared the crater, the rocks grew warm, and sulphur and other fumes streaked the air.

When a half-mile from the crater we dismounted, and, leaving our horses in charge of the guide, proceeded on foot over the cracked and heated lava rocks toward the brink of this veritable devil's caldron. The sulphur fumes are so suffocating that it can be approached only on the windward side. The first glance into that fearful pit is all that your imagination can picture it. You look upon the traditional lake of brimstone and fire, and if devils were to appear skipping about over the surface with pitchforks, turning their victims as the cook turns her frying crullers in the sputtering fat, it would not much astonish you. This liquid is rather thick and viscid, but it is boiling furiously. Great masses of it are thrown up forty or fifty feet, and fall with a crash like that of the surf upon the shore. Livid jets are thrown up many feet high against the sides and drip back, cooling quickly as the lava descends. We sat or stood upon the brink, at times almost letting our feet hang over the sides, and shielding our faces from the intense heat with paper masks and veils. It is probably the only place in the world where you can come face to face with the heart of

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an active volcano. There are no veils of vapor to hide it from you. It appears easy enough to cast a stone into the midst of it, but none of us could quite do it.

The mass of boiling lava is said to be about one and one half acres in extent. Its surface is covered with large masses of floating crust, black and smooth, like leather or roofing-paper, and between these masses, or islands, the molten lava shows in broad, vivid lines. It is never quiet. When not actually boiling, there is a slow circulatory movement, and the great flakes of black crust, suggesting scum, drift across from one end to the other and are drawn under the rocks. At one moment only this movement is apparent, then suddenly the mass begins to boil furiously all over the surface, and you hear dimly the sound of the bursting bubbles and the crash of the falling lava. When this takes place, the black floating masses are broken up and scattered as they are in boiling maple-syrup, but they quickly reunite, and are carried on by the current as before.

Looking upon this scene with the thought of the traditional lake of fire and brimstone of our forefathers in mind, you would say that these black, filthy-looking masses floating about on the surface were the accumulation of all the bad stuff that had been fried out of the poor sinners since hell was invented. How much wickedness and uncharity and

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evil thought it would represent! If the poor victims were clarified and made purer by the process, then it would seem worth while.

At the Volcano House they keep a book in which tourists write down their impressions of the volcano. A distinguished statesman had been there a few days before us, and had written a long account of his impressions, closing with this oratorical sentence: "No pen, however gifted, can describe, no brush, however brilliant, can portray, the wonders we have been permitted to behold." I could not refrain from writing under it, "I have seen the orthodox hell, and it's the real thing."

That huge kettle of molten metal, mantling and bubbling, how it is impressed upon my memory! It is a vestige of the ancient cosmic fire that once wrapped the whole globe in its embrace. It had a kind of brutal fascination. One could not take one's eyes from it. That network of broad, jagged, fiery lines defining those black, smooth masses, or islands, of floating matter told of a side of nature we had never before seen. We lingered there on the brink of the fearful spectacle till night came on, and the sides of the mighty caldron, and the fog-clouds above it, glowed in the infernal light. Not so white as the metal pouring from a blast furnace, not so hot, a more sullen red, but welling up from the central primordial fires of the earth. This great pot has boiled over many times in the recent past, as the

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lava-beds we traveled over testify, and it will probably boil over again. It has been unusually active these last few years.

About nine o'clock we rode back, facing a cold, driving mist, the back of each rider, protected by the shining yellow "slickers," glowing to the one behind him, in the volcano's light, till we were a mile or more away.

The next morning came clear, and the sight of the mighty slope of Mauna Loa, lit up by the rising sun, was a grand spectacle. It looked gentle and easy of ascent, wooded here and there, and here and there showing broad, black streaks from the lava overflows at the summit in recent years; but remembering that it was nearly four thousand feet higher than Haleakala, I had no desire to climb it. This mountain and its companion, Mauna Kea, are the highest island mountains in the world.

The stage rolled us back through the fern forest to the railway station and thence on to Hilo again, where in good time, in the afternoon, we went aboard the steamer; and the next morning we were again in the harbor of Honolulu, glad we had made the inter-island trip, and above all glad that we had seen Haleakala.

VI

THE OLD ICE-FLOOD

I

HE was a bold man who first conceived the idea of the great continental ice-sheet which in Pleistocene times covered most of the northern part of the continent, and played such a part in shaping the land as we know it. That bold man was Agassiz, who, however, was not bold enough to accept the theory of evolution as propounded by Darwin. The idea of the great glacier did not conflict with Agassiz's religious predilections, and the theory of evolution did. It was a bold generalization, this of the continental ice-sheet, one of the master-strokes of the scientific imagination. It was about the year 1840 that Agassiz, fresh from the glaciers of the Alps, went to Scotland looking for the tracks of the old glaciers, and he found them at once when he landed near Glasgow. We can all find them now on almost every walk we take to the fields and hills; but until our eyes are opened, how blind we are to them! We are like people who camp on the trail of an army and never suspect an army has passed, though the ruts made by their wagons and artillery and

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the ruins of their intrenchments are everywhere visible.

When I was a boy on the farm we never asked ourselves questions about the stones and rocks that encumbered the land — whence they came, or what the agency was that brought them. The farmers believed the land was created just as we saw it — stones, boulders, soil, gravel-pits, hills, mountains, and all — and doubtless wished in their hearts that the Creator had not been so particular about the rocks and stones, or had made an exception in favor of their own fields. Rocks and stones were good for fences and foundations, and for various other uses, but they were a great hindrance to the cultivation of the soil. I once heard a farmer boast that he had very strong land — it had to be strong to hold up such a crop of rocks and stones. When the Eastern farmer moved west into the prairie states, or south into the cotton-growing states, he probably never asked himself why the Creator had not cumbered the ground with rocks and stones in those sections, as he had in New York and New England. South of the line that runs irregularly through middle New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Iowa, and so on to the Rockies, he will find few loose stones scattered over the soil, no detached boulders sitting upon the surface, no hills or mounds of gravel and sand, no clay banks packed full of rounded stones, little and big, no

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rocky floors under the soil which look as if they had been dressed down by a huge but dulled and nicked jack-plane. The reason is that the line I have indicated marks the limit of the old ice-sheet which more than a hundred thousand years ago covered all the northern part of the continent to a depth of from two to four thousand feet, and was the chief instrument in rounding off mountain-tops, scattering rock-fragments, little and big, over our landscapes, grinding down and breaking off the protruding rock strata, building up our banks of mingled clay and stone, changing the courses of streams and rivers, deepening and widening our valleys, transplanting boulders of one formation for hundreds of miles, and dropping them upon the surface of another formation. When it began to melt and retreat, it was the chief agent in building up our river terraces, and our long, low, rounded hills of sand and gravel and clay, called kames and drumlins. In many of our valleys its flowing waters left long, low ridges, gentle in outline, made up entirely of sand and gravel, or of clay. In other places it left moraines made up of earth, gravel, and rock-fragments that make a very rough streak through the farmer's land. All those high, level terraces along the Hudson, such as that upon which West Point stands, were the work of the old ice-sheet that once filled the river valley. The melting ice was also the chief agent in building up the enormous clay-banks

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that are found along the shores of the Hudson. The clay formed in very still waters, the sand and gravel in more active waters.

This great ice-sheet not only covered our northern farms with rocks and stones, and packed the soil with rounded boulders, but it also carried away much of the rock decay that goes to the making of the soil, so that the soil is of greater depth in the non-glaciated than in the glaciated areas of the country. The New-Englander or New-Yorker in traveling in the Southern States may note the enormous depth of soil as revealed by the water-courses or railroad cuts. The ice-sheet was a huge mill that ground up the rocks in the North probably as fast or faster than the rains and the rank vegetation reduced them in the South, but the floods of water which it finally let loose carried a great deal of the rock-waste into the sea.

The glacier milk which colors the streams that flow from beneath it finally settles and makes clay. Off the great Malaspina Glacier in Alaska the ocean is tinged by the glacier milk for nearly fifty miles from the shores. Very few country people, even among the educated, are ready to believe that this enormous ice-sheet ever existed. To make them believe that it is just as much a fact in the physical history of this continent as the war of the Revolution is a fact in our political history is no easy matter. It certainly is a crushing proposition. It so vastly

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transcends all our experience with ice and snow, or the experience of the race since the dawn of history, that only the scientific imagination and faith are equal to it. The belief in it rests on indubitable evidence, its record is written all over our landscape, but it requires, I say, the scientific imagination to put the facts together and make a continuous history.

Three or four hundred feet above my cabin, five or six hundred feet above tidewater, there is a bold rocky point upon which the old ice-sheet bore heavily. It has rubbed it down and flattened it as a hand passing over a knob of soft putty might do. The great hand in this case moved from the northeast and must have fairly made this rocky prominence groan with its weight. The surface, scratched and grooved and planed by the ice, has weathered away, leaving the rock quite rough; its general outlines alone tell the tale of the battle with the ice. But on the east side a huge mass of rock, that had been planed and gouged by the glacier, was detached and toppled over, turning topsy-turvy before it had weathered, and it lies in such a position, upheld by two rock fragments, that its glaciated surface, though protected from the weather, is clearly visible. You step down two or three feet between the two upholding rocks and are at the entrance of a little cave, and there before you, standing at an angle of thirty or forty degrees, is this rocky page

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written over with the history of the passing of the great ice plane. The surface exposed is ten or twelve feet long, and four or five feet wide, and it is as straight and smooth, and the scratches and grooves are as sharp and distinct as if made yesterday. I often take the college girls there who come to visit me, to show them, as I tell them, where the old ice gods left their signatures. The girls take turns in stooping down and looking along the under surface of the rock, and feeling it with their hands, and marveling. They have read or heard about these things, but the reading or hearing made little impression upon their minds. When they see a concrete example, and feel it with their hands, they are impressed. Then when I tell them that there is not a shadow of a doubt but that the ice was at one time two or three thousand feet thick above the place where they now stand, and that it bore down upon Julian's Rock with a weight of thousands of tons to the square foot, that it filled all the Hudson River Valley, and covered the landscape for thousands of miles around them, riding over the tops of the Catskills and of the Adirondacks, and wearing them down and carrying fragments of rock torn from them hundreds of miles to the south and southwest, — when I have told them all of this, I have usually given them a mouthful too big for them to masticate or swallow. As a sort of abstract proposition contained in books, or heard in the classroom, they do

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not mind it, but as an actual fact, here in the light of common day on the hill above Slabsides, with the waters of the Hudson glistening below, and the trees rustling in the wind all about us, that is quite another matter. It sounds like a dream or a fable. Many of the processes that have made our globe what we see it have been so slow and on such a scale that they are quite beyond our horizon — beyond the reach of our mental apprehension. The mind has to approach them slowly and tentatively, and become familiar with the idea of them, before it can give any sort of rational assent to them. It has taken the geologist a long time to work out and clear up and confirm this conception of the great continental glacier which in Pleistocene times covered so large a part of the northern hemisphere. It is now as well established as any event in the remote past well can be. In Alaska, and in the Swiss Alps, one may see the ice doing exactly what the Pleistocene ice-sheet did over this country.

II

The other day in passing a farmer's house I saw where he had placed a huge, roundish boulder, nearly as high as a man's head, by the roadside and had cut upon it his own name and date, and that of his father before him, and that of the first settler upon the farm, in the latter part of the eighteenth century. It was an interesting monument. I

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learned that the rock had been found in the bed of a small creek near by, and that the farmer had given a hundred dollars to have it moved to its place in front of his house. Had I seen the old farmer I am sure I could have added to his interest and pride in his monument by telling him that it was Adirondack gneiss, and had been brought from that region on the back, or in the maw, of a glacier, many tens of thousands of years ago. But it is highly probable that, were he an uneducated man, he would have treated my statement with contempt or incredulity. Education does at least this for a man: it opens his mind and makes him less skeptical about things not dreamed of in his philosophy.

This boulder had been rolled and worn in its long, slow ride till it was nearly round. I have a much smaller boulder, probably from the same quarry, which I planted at the head of my garden for a seat when the hoe gets tired. When it was dropped here on the land that is now my field, the bed and valley of the Hudson were occupied by the old glacier which, during its decline and recession, built up the terraces opposite me (where now stands a multimillionaire's copy of an Italian palace), and which added to and uncovered the river slopes where now my own vineyards are planted.

The flowing or the creeping of this old ice-sheet, so that it could transport large boulders hundreds of miles, is one of the most remarkable things about

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it: as slow or slower than the hour-hand of the clock, yet an actual progression, carrying it, in the course of thousands of years, from its apex in Labrador well down into New Jersey, where its terminal moraine is still clearly traceable.

A river of ice, under the right conditions, flows as literally as a river of water, fastest in the middle, and slowest along its margins where the friction is greatest. The old ice-sheet, or ice sea, flowed around and over mountains as a river flows around and over rocks. Where a mountain rose above the glacier, the ice divided and flowed round it, and reunited again beyond it. One may see all this in Alaska at the present time. Water, of course, flows because of its own pressure; so does ice, only the pressure has to be vastly greater. A drop of water on the table does not flow, but, pile it high enough, and it will. The old ice sea flowed mainly south, not because it was downhill in that direction, but because the accumulation of ice and snow at the North was so great. If through any climatic changes, the snow-fall were ever again to be so great that more snow should fall in winter than could melt in summer, after the lapse of thousands of years, we should have another ice age.

VII

THE FRIENDLY SOIL

I NEVER tire of contemplating the soil itself, the mantle rock, as the geologist calls it. It clothes the rocky framework of the earth as the flesh clothes our bones. It is the seat of the vitality of the globe, the youngest part, the growing, changing part. Out of it we came, and to it we return. It is literally our mother, as the sun is our father.

The soil! — the residuum of the rocks, the ashes of the mountains. We know what a vast stretch of time has gone to the making of it; that it has been baked and boiled and frozen and thawed, acted upon by sun and star and wind and rain; mixed and remixed and kneaded and added to, as the housewife kneads and moulds her bread; that it has lain under the seas in the stratified rocks for incalculable ages; that chemical and mechanical and vital forces have all had a hand in its preparation; that the vast cycles of animal and vegetable life of the foreworld have contributed to its fertility; that the life of the sea, and the monsters of the earth, and the dragons of the air, have left their ashes here, so that when I stir it with my hoe, or turn it with my spade, I know

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I am stirring or turning the meal of a veritable grist of the gods.

From its primal source in the Archæan rock, up through all the vast series of sedimentary rocks to our own time, what vicissitudes and transformations it has passed through; how many times it has died, so to speak, and been reborn from the rocks; how many times the winds and the rains have transported it, and infused invisible, life-giving gases into it; how many of the elements have throbbed with life, climbed and bloomed in trees, walked or flown or swam in animals, or slumbered for thousands upon thousands of years beneath the great ice-sheet of Pleistocene time! A handful of the soil by your door is probably the most composite thing you can find in a day's journey. It may be an epitome of a whole geological formation, or of two or more of them. If it happens to be made up of decomposed limestone, sandstone, slate, and basalt rock, think what a history would be condensed in it!

Our lawns are made up of ashes from the funeral pyre of mountains, of dust from the tombs of geologic ages. What masses of rock does this sandbank represent! what an enormous grist in the great glacier mill do these layers of clay stand for! Two feet of soil probably represent a hundred feet or more of rock. Strictly speaking, the soil is the insoluble parts of the ground-up and decomposed rocks, after the rains and the winds have done their work

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and taken their toll of the grist they have ground. Sometimes these mills take the whole grist and leave the rocks bare; but usually they leave a residuum in which life strikes its roots. We do not see all that the waters take from the soil. They have invisible pockets in which they carry away all the more soluble parts, such as lime, soda, potash, silica, magnesia, and others, and leave for the land the more insoluble parts. These, too, in times of flood they carry away in suspension, in the shape of sand, silt, mud, gravel, and the like. When the waters really digest the rocks, they hold the various minerals in solution, and run limpid and dancing to the sea; when they have an undigested burden, they run angry and turbid.

It is estimated that the Hudson River deposits in the sea each year four hundred and forty thousand tons of mineral matter in solution which it has taken from the land, and the Mississippi one hundred and twelve million tons. Each carries away about four times as much in suspension. The digestive or chemical power of water, then, is only about one fourth as great as its mechanical power. Between the two the land is made to pay heavy toll to the sea. But in time, in geologic time, it all comes back. The suspended particles are dropped and go to make up the sedimentary rocks, while the solutes help cement the material of these rocks together, and also nourish the sea life from which limestone

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and other organic rocks are made. When these rocks are again lifted to the surface and disintegrated into soil, then the debt of the sea to the land is paid. This process, this cycle of soil loss and soil growth, has gone on through all time, and must continue as long as the rain continues to fall, or as long as the sea continues to send its tax-gatherers to the land. In this great cycle of give and take of the elements, the affairs of men cut but a momentary figure; how puny they are, how transient! How the great changes, which in time amount to revolutions, go on over our heads and under our feet, and we rarely heed them, and are powerless to stay them! A summer shower carries the soil of my side-hill, which is mainly disintegrated Silurian rock and shale, into the river, and some millions of years hence, when it has become stratified rock, and been lifted up into the light of day, some other, and, I trust, wiser husbandman, will be gathering his harvest from it, and be worried over the downpour that robs him of it. The farmer's worry is bound to come back with the soil, and be passed along with it.

VIII

PRIMAL ENERGIES

HOW puny and meagre is the utmost power man can put forth, even by the aid of all his mechanical appliances, when compared with the primal earth forces! Think, or try to think, of the force of pressure that causes the rock-strata to buckle or crumple or bend — layers of rock, thousands of feet thick, made to fold and bend like the leaves of a book — vast mountain-chains flexed and foreshortened, or ruptured and faulted as the bending of one's body wrinkles or rips one's clothes. Think of the over-thrusts and the folding and shearing of the earth's crust. The shrinking of the earth squeezes the rocks to an extent quite beyond our power of conception. "So overpowering has been the horizontal movement in some cases," says Dana, "that masses of rock thousands of feet in thickness have been buckled up and sheared, or, simply yielding to pressure, have sheared without folding, and been thrust forward for miles along a gently inclined plane. These great reversed faults are termed over-thrusts or thrust-planes. Sometimes such thrust-planes occur singly, at other times the rocks have yielded again and again, great sheets having been sliced off successively, and driven for-

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ward one upon the other." In northern Montana there is an over-thrust of the Cambrian rocks upon the late Cretaceous, of seven or eight miles, carrying with it what is now called "Chief Mountain," which has been carved out of the extreme end of the over-thrust. The contemplation of such things gives one a sense of power in Nature beyond anything else I know of. The shrinking of the globe as a whole makes its rocky garment too big for it, and this titanic wrinkling and folding results. When the strata snap asunder under the strain, we have earthquakes. During the recent San Francisco earthquake, Mount Tamalpais, across the bay, and all the neighboring heights, were permanently shifted eight or ten feet. The sides of the mountain, it is said, undulated like a curtain. And this shaking and twitching of the great rocky skin of the earth was vastly less, in proportion to the size of the globe, than the twitching and trembling of the skin of a horse when he would shake off the flies, in comparison with the animal's body.

We see another exhibition of the magnitude of the earth's forces in what the geologist calls a "laccolite" — a great cave or cistern deep beneath the surface of stratified rock filled with hardened lava. The lava is forced up from an unknown depth under such pressure that, not finding an outlet at the surface, the rock strata, hundreds or thousands of feet thick, are lifted up and arched like so much paper,

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and in the cavity thus formed the pent-up molten lava finds relief. These lava cisterns or pockets are sometimes uncovered by the process of erosion. The Henry Mountains in Utah are all laccolites. One of them, Mount Hillers, has a volume of about ten cubic miles. Much of the overarching sedimentary strata still covers it. Geologists read the evidence of a similar formation called a "sill" on the west side of the Hudson in New Jersey, forming the Palisades. The lava worked like a giant mole up through and then beneath the Triassic sandstone, lifting the strata up and arching them over a large area. During the millions of years that have elapsed since that time, the layers of superincumbent sandstone have been worn away so that now one sees a wide, smooth, gentle slope of basaltic rock covered by a very thin coat of soil. As one goes by on the train, one sees where the workmen of a stone-crushing plant have cut into the slope and uncovered the junction of the two kinds of rock, one born of water, and one born of fire. The igneous rock sits squarely upon the level sandstone, like a row of upright books standing upon a shelf. I never pass the place but that I want to stop the train and get out and have a close look at the precise spot where this son of Vulcan sat down so heavily and so hot upon his brother of the sedimentary deposits.

Probably no two chapters of the earth's history differ more than those of the two sides of the Hud-

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son at New York. There is a great break here — a leap from Archæan times on the east side to Mesozoic times on the west. The east side is millions of years the older. Here is the original Plutonic or Azoic rock which apparently has never been under the sea since it was first thrust up out of the fiery depths. The west shore, including the Palisades, belongs to a much later geologic era. The original granite here is buried under vast deposits of sedimentary rock of the Triassic age — the age of the giant reptiles, the remains of one of which has recently been found embedded in this sandstone, near the river's edge. As the traveler's eye follows along the even, almost level line of this escarpment of the Palisades, let it re-create for him the strata of the old Triassic sandstone that were millions of years ago piled high upon it, — how high can only be conjectured, — but which have been removed grain by grain under the eroding power of the forces of air and water that now seem to caress the huge wall so gently. Ah! geologic Time, what can it not do? what has it not done? The old sill of Vulcan now presents a nearly vertical front to the Hudson, forming the Palisades, showing that some leaves of the earth's history here are missing, buried probably beneath the waters of the river. There is evidently a line of fault here, and the west side has been lifted up out of the old Mesozoic seas, probably in the convulsions that poured out the lava of the trap rock.

IX

SCIENTIFIC FAITH

I FIND myself accepting certain things on the authority of science which so far transcend my experience, and the experience of the race and all the knowledge of the world, in fact which come so near being unthinkable, that I call my acceptance of them an act of scientific faith. One's reason may be convinced and yet the heart refuse to believe. It is not so much a question of evidence as a question of capacity to receive evidence of an unusual kind.

One of the conclusions of science which I feel forced to accept, and yet which I find very hard work to believe, is that of the animal origin of man. I suppose my logical faculties are convinced, but what is that in me that is baffled, and that hesitates and demurs?

The idea of the origin of man from some lower form requires such a plunge into the past, and such a faith in the transforming power of the biological laws, and in the divinity that lurks in the soil underfoot and streams from the orbs overhead, that the ordinary mind is quite unequal to the task. For the book of Genesis of the old Bible we have substituted

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the book of genesis of the rocky scripture of the globe — a book torn and mutilated, that has been through fire and flood and earthquake shock, that has been in the sea and on the heights, and that only the palæontologist can read or decipher correctly, but which is a veritable bible of the succession of life on the earth. The events of the days of creation are recorded here, but they are days of such length that they are to be reckoned only in millions of years.

The evolution of the horse, according to the best and latest research, from the eohippus of Eocene times — a small mammal no larger than the fox — to the proud and fleet creature that we prize to-day, occupied four or five millions of years. Think of that first known progenitor of the horse as never dying, but living on through the geological ages and being slowly, oh, so slowly, modified by its environment, changing its teeth, its hoofs, enlarging its body, lengthening its limbs, and so on, till it becomes the horse we know to-day.

In accepting the theory of the animal origin of man we have got to follow man back, not only till we find him a naked savage like the Fuegians as Darwin describes them, — naked, bedaubed with paint, with matted hair and looks wild and distrustful, — but we cannot stop there, we must follow him back till he becomes a troglodyte, a cave-dweller, contending with the cave bear, the cave lion, and the hyena for the possession of this rude shelter;

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back still, till we find him in trees living like the anthropoid apes; then back to the earth again to some four-footed creature, probably of the marsupial kind; still the trail leads downward and ever downward, till we lose it in that maze of marine forms that swarm in the Palæozoic seas, or until the imagination is baffled and refuses to proceed. It certainly is a hard proposition, and it puts one upon his mettle to accept it.

Should we not find equal difficulty in believing the life-history of each one of us, — the start in the germ, then the vague suggestion of fish, and frog, and reptile, in our foetal life, — were it not a matter of daily experience? Let it be granted that the race of man was born as literally out of the animal forms below him as the child is born out of these vague, prenatal animal forms in its mother's womb. Yet the former fact so far transcends our experience, and even our power of imagination, that we can receive it only by an act of scientific faith, as our fathers received the dogmas of the Church by an act of religious faith.

I confess that I find it hard work to get on intimate terms with evolution, familiarize my mind with it, and make it thinkable. The gulf that separates man from the orders below him is so impassable, his intelligence is so radically different from theirs, and his progress so enormous, while they have stood still, that believing it is like believing a miracle.

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That the apparently blind groping and experimentation which mark the course of evolution as revealed by palæontology — the waste, the delay, the vicissitudes, the hit-and-miss method — should have finally resulted in this supreme animal, man, puts our scientific faith to the test. In the light of evolution how the halo with which we have surrounded our origin vanishes!

Man has from the earliest period believed himself of divine origin, and by the divine he has meant something far removed from this earth and all its laws and processes, something quite transcending the mundane forces. He has invented or dreamed myths and legends to throw the halo of the exceptional, the far removed, the mystical, or the divine around his origin. He has spurned the clod with his foot; he has denied all kinship with bird and beast around him, and looked to the heavens above for the sources of his life. And then un pitying science comes along and tells him that he is under the same law as the life he treads under foot, and that that law is adequate to transform the worm into the man; that he, too, has groveled in the dust, or wallowed in the slime, or fought and reveled, a reptile among reptiles; that the heavens above him, to which he turns with such awe and reverence, or such dread and foreboding, are the source of his life and hope in no other sense than they are the source of the life and hope of all other creatures. But this is the way of science;

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it enhances the value or significance of everything about us that we are wont to treat as cheap or vulgar, and it discounts the value of the things far off upon which we have laid such stress. It ties us to the earth, it calls in the messengers we send forth into the unknown; it makes the astonishing revelation — revolutionary revelation, I may say — that the earth is embosomed in the infinite heavens the same as the stars that shine above us, that the creative energy is working now and here underfoot, the same as in the ages of myth and miracle; in other words, that God is really immanent in his universe, and inseparable from it; that we have been in heaven and under the celestial laws all our lives, and knew it not. Science thus kills religion, poetry, and romance only so far as it dispels our illusions and brings us back from the imaginary to the common and the near at hand. It discounts heaven in favor of earth. It should make us more at home in the world, and more conscious of the daily beauty and wonders that surround us, and, if it does not, the trouble is probably in the ages of myth and fable that lie behind us and that have left their intoxicating influence in our blood.

We are willing to be made out of the dust of the earth when God makes us, the God we have made ourselves out of our dreams and fears and aspirations, but we are not willing to be made out of the dust of the earth when the god called Evolution

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makes us. An impersonal law or process we cannot revere or fear or worship or exalt; we can only study it and put it to the test. We can love or worship only personality. This is why science puts such a damper upon us; it banishes personality, as we have heretofore conceived it, from the universe. The thunder is no longer the voice of God, the earth is no longer his footstool. Personality appears only in man; the universe is not inhuman, but unhuman. It is this discovery that we recoil from, and blame science for; and until, in the process of time, we shall have adjusted our minds, and especially our emotions, to it, mankind will still recoil from it.

We love our dreams, our imaginings, as we love a prospect before our houses. We love an outlook into the ideal, the unknown in our lives. But we love also to feel the solid ground beneath our feet.

Whether life loses in charm as we lose our illusions, and whether it gains in power and satisfaction as we more and more reach solid ground in our beliefs, is a question that will be answered differently by different persons.

We have vastly more solid knowledge about the universe amid which we live than had our fathers, but are we happier, better, stronger? May it not be said that our lives consist, not in the number of things we know any more than in the number of things we possess, but in the things we love, in the depth and sincerity of our emotions, and in the ele-

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vation of our aspirations? Has not science also enlarged the sphere of our love, and given us new grounds for wonder and admiration? It certainly has, but it as certainly has put a damper upon our awe, our reverence, our veneration. However valuable these emotions are, and whatever part they may have played in the development of character in the past, they seem doomed to play less and less part in the future. Poetry and religion, so called, seem doomed to play less and less part in the life of the race in the future. We shall still dream and aspire, but we shall not tremble and worship as in the past.

We see about us daily transformations as stupendous as that of the evolution of man from the lower animals, and we marvel not. We see the inorganic pass into the organic, we see iron and lime and potash and silex blush in the flowers, sweeten in the fruit, ripen in the grain, crimson in the blood, and we marvel not. We see the spotless pond-lily rising and unfolding its snowy petals, and its trembling heart of gold, from the black slime of the pond. We contemplate our own life-history as shown in our pre-natal life, and we are not disturbed. But when we stretch this process out through the geologic ages and try to see ourselves a germ, a fish, a reptile, in the womb of time, we are balked. We do not see the great mother, or the great father, or feel the lift of the great biologic laws. We are beyond our depth. It

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is easy to believe that the baby is born of woman, because it is a matter of daily experience, but it is not easy to believe that man is born of the animal world below him, and that that is born of inorganic Nature, because the fact is too big and tremendous.

What we call Nature works in no other way; one law is over big and little alike. What Nature does in a day typifies what she does in an eternity. It is when we reach the things done on such an enormous scale of time and power and size that we are helpless. The almost infinitely slow transformations that the theory of evolution demands balk us as do the size and distance of the fixed stars.

No observation or study of evolution on a small scale and near at hand in the familiar facts of the life about us can prepare us for it; any more than lake and river can prepare us for the ocean, or the modeling of miniature valleys and mountains by the rain in the clay bank can open our minds to receive the tremendous facts of the carving of the face of the continent by the same agents.

We do not see evolution working in one day, or in a century, or in many centuries. Neither do we catch the gods of erosion at their Herculean tasks. They always seem to be having a holiday, or else to be merely toying with their work.

When we see a mound of earth or a bank of clay worn into miniature mountain-chains and cañons and gulches by the rains of a season, we do not

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doubt our eyes; we know the rains did it. But when we see the same thing copied in a broad landscape, or on the face of a state or a continent, we find it hard to believe the evidence of our own senses. The scale upon which it is done, and the time involved, put it so far beyond the sphere of our experience that something in us, probably the practical, every-day man, refuses to be convinced.

The lay mind can hardly have any adequate conception of the part erosion, the simple weathering of the rocks, has played in shaping our landscapes, and in preparing the earth for the abode of man. The changes in the surface of the land in one's lifetime, or even in the historic period, are so slight that the tales the geologists tell us are incredible.

When, during a recent trip through the great Southwest, I saw the earth laid open by erosion as I had never before dreamed of, especially when I visited those halls of the gods, the Grand Cañon and Yosemite Valley, I found my capacity to believe in the erosive power of water and the weather quite overtaxed. It must be true, I said, what the geologists tell us, that water and air did all this; but while you look and wait, and while generations before you have looked and waited, all is as quiet and passive as if the slumber of ages wrapped hill and vale. Invisible giants have wrought and delved here of whom we never catch a glimpse, nor shall we, wait and watch we never so long. No sound of their

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hammers or picks or shovels or of the dynamite ever breaks the stillness of the air.

I have to believe that the valleys and mountains of my native Catskills were carved out of a great elevated plain or plateau; there is no other explanation of them. Here lie the level strata, without any bending or folding, or sign of convulsion and upheavals, horizontal as the surface of the sea or lake in which their sediments were originally laid down; and here are these deep, wide valleys cut down through these many sheets of stratified rock; and here are these long, high, broad-backed mountains, made up of the rock that the forces of air and water have left, and with no forces of erosion at work that would appreciably alter a line of the landscape in ten thousand years; and yet we know, if we know anything about the physical history of the earth, that erosion has done this work, carved out these mountains and valleys, from the Devonian strata, as literally as the sculptor carves his statue from the block of marble.

Above my lodge on the home farm the vast layers of the gray, thin-sheeted Catskill rock crop out and look across the valley to their fellows two or more miles away where they crop out in a similar manner on the opposite slope of the mountain. With the eye of faith I see the great sheets restored, and follow them across on the line which they made æons ago, till they are joined again to their fellows

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as they were before the agents of erosion had so widely severed them.

These physical forces have worked as slowly and silently in sculpturing the landscapes as the biological laws have worked in evolving man from the lower animals, or the vertebrates from the invertebrates. The rains, the dews, the snows, the winds — how could these soft, gently careering agents have demolished these rocks and dug these valleys? One would almost as soon expect the wings and feet of the birds to wear away the forests they flit through. The wings of time are feathered also, and as they brush against the granite or the flinty sandstone no visible particle is removed while you watch and wait. Come back in a thousand years, and you note no change, save in the covering of trees and verdure. Return in ten thousand, and you would probably find the hills carrying their heads as high and as proudly as ever. Here and there the face of the cliff may have given way, or a talus slid into the valley, or a stream or river changed its course, or sawed deeper into the rock, and a lake been turned into a marsh, or the delta of a river broadened — minor changes, such as a shingle from your roof or a brick from your chimney, while your house stands as before. In one hundred thousand years what changes should we probably find? Here in the Catskills, where I write, the weathering of the hills and mountains would probably have been but slight. It must

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be fifty thousand years or more since the great ice-sheet left us. Where protected by a thin coat of soil, its scratches and grooves upon the surface rock are about as fresh and distinct as you may see them made in Alaska at the present time. Where the rock is exposed, they have weathered out, one eighth of an inch probably having been worn away. The drifting of the withered leaves of autumn, or of the snows of winter over them, it really seems, would have done as much in that stretch of time. Then try to fancy the eternity it has taken the subaerial elements to cut thousands of feet through this hard Catskill sandstone! No, the evolution of the landscape, the evolution of the animal and vegetable kingdoms, the evolution of the suns and planets, involve a process so slow, and on such a scale, that it is quite unthinkable. How long it took evolution to bridge the chasm between the vertebrate and the invertebrate, between the fish and the frog, between the frog and the reptile, between the reptile and the mammal, or between the lowest mammal and the highest, who can guess?

But the gulf has been passed, and here we are in this teeming world of life and beauty, with a terrible past behind us, but a brighter and brighter future before us.

X

“THE WORM STRIVING TO BE MAN”

WHEN our minds have expanded sufficiently to take in and accept the theory of evolution, with what different feelings we look upon the visible universe from those with which our fathers looked upon it! Evolution makes the universe alive. In its light we see that mysterious potency of matter itself, that something in the clod under foot that justifies Emerson's audacious line of the "worm striving to be man." We are no longer the adopted children of the earth, but her own real offspring. Evolution puts astronomy and geology in our blood and authenticates us and gives us the backing of the whole solar system. This is the redemption of the earth: it is the spiritualization of matter.

In imagination stand off in vacant space and see the earth rolling by you, a huge bubble with all its continents and seas and changing seasons and countless forms of life upon it, and remember that you are looking upon a great cosmic organism, pulsing with the vital currents of the universe, and that what it holds of living forms were not arbitrarily imposed

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upon it from without, but vitally evolved from within and that man himself is one of its products as literally as are the trees that stand rooted to the soil. Revert to the time when life was not, when the globe was a half-incandescent ball, or when it was a seething, weltering waste of heated water, before the land had yet emerged from the waves, and yet you and I were there in the latent potencies of the chemically and dynamically warring elements. We were there, the same as the heat and flame are in the coal and wood and as the explosive force of powder is in the grains. The creative cosmic chemistry in due time brought us forth, and started us on the long road that led from the amoeba up to man. There have been no days of creation. Creation has been a continuous process, and the creator has been this principle of evolution inherent in all matter.

Man himself was born of this principle. His genealogy finally runs back to the clod under his feet. One has no trouble in accepting the old Biblical account of his origin from the dust of the earth when one views that dust in the light of modern science.

Man is undoubtedly of animal origin. He is embraced in the same zoölogical scheme as are all other creatures, and did not start as man any more than you and I started with our present stature, or than the earth sprang from chaos as we now behold it.

His complete physical evolution must have been

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achieved thousands of centuries ago, but his full mental and spiritual evolution is not yet.

I think of his physical evolution as completed when he assumed the upright attitude or passed from a quadruped to a biped, which must of itself have been a long, slow process. Probably our whole historic period would form but a fraction of this cycle of unrecorded time. Man's complete emergence from the lower orders, so that he stood off in sharp contrast to them in his physical form probably occurred in later Tertiary times, and what the meaning of this stretch of time is in human years we can only conjecture. During this cycle of numberless millenniums till the dawn of history, man's development was mainly mental. He left the brute creature behind because his mind continued to develop after his physical form was complete, while the brute stood still. Whence the impulse that sent man forward? Why was one animal form endowed with the capacity for endless growth and development, and all the others denied it? Ah! that is the question of questions. Compared with the development of his bodily powers, man's mental and spiritual growth has been very rapid. He seems to have been millions of years in getting his body, while he has been only millenniums in getting his reason and intelligence. What progress since the dawn of history! Compare the Germans of the time of Tacitus, or the Gauls of the time of Cæsar, or the Britons of the

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time of Hadrian with the people of those countries to-day.

We are prone to speak of man's emergence from the lower orders as if it were a simple thing, almost like the going from one country into another. But try to think what it means; try to think of the slow transformation, of the long, toilsome road even from the halfway house of our simian ancestors. If we do not give him the benefit of the sudden mutation theory of the origin of species, then think of the slow process, hair by hair, as it were, by which a tailed, apelike arboreal animal was transformed into a hairless, tailless, erect, tool-using, fire-using, speech-forming animal. We see in our own day in the case of the African negro, that centuries of our Northern climate have hardly any appreciable effect toward making a white man of him; nor, on the other hand, has exposure to the tropical sun had much more effect in making a negro of the white man. Probably it would take ten thousand years or more of these conditions to bleach the pigments out of the one skin and put them in the other. There is convincing proof from painting and figures found in Egypt that neither the African negro nor the Egyptian has changed in features in five thousand years.

The most marvelous thing about man's evolution is the inborn upward impulse in some one low organism that rested not till it reached its goal in

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him. The mollusk remains, but some impulse went out from the mollusk that begat the fish. The fish remains, but some impulse went out from the fish that begat the amphibian. The amphibian remains, but some impulse went out from the amphibian that begat the reptile. The reptile remains, but some impulse went out from the reptile that begat the mammal; and so on up to man. Man must have had a specific line of descent. One golden thread must connect him with the lowest forms of life. And the wonder is that this golden thread was never snapped or lost through all the terrible vicissitudes of the geologic ages. But I suppose it is just as great a wonder that the line of descent of the horse, or the sheep, or the dog, or the bird, was not snapped or lost. Some impulse or tendency was latent or potential in the first unicellular life that rested not till it eventuated in each of these higher forms. Did any terrestrial or celestial calamity endanger the line of descent of any of the higher creatures? Was any form cut off in the world-wide crustal disturbances of the earth at the end of palæozoic and mesozoic time, when so many forms of animal life appear to have been wiped out, that might in time have given birth to a kind unlike or superior to any now upon the earth? Species after species have become extinct, whole orders and families have gone out, often rather suddenly. Why we know not. Why the line of man's descent was not cut off, who knows? It is a vain

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speculation. There can be little doubt that in early Tertiary times our ancestor was a small, feeble mammal, maybe of the lemur, maybe of the marsupial kind, powerless before the great carnivorous mammals of that time, and probably escaping them by his greater agility, perhaps by his arboreal habits. The ancestor of the horse was also a small creature at that time, not larger than a fox. It was not cut off; the line of descent seems complete to the horse of our day. Small beginnings seem to be the rule in all provinces of life. There is little doubt that the great animals of our day — the elephant, the whale, the lion, — all had their start in small forms. Many of these small forms have been found. But a complete series of any of the animal forms that eventuated in any of the dominant species is yet wanting. It is quite certain that the huge, the gigantic, the monstrous in animal, as in vegetable life, lies far behind us. Is it not quite certain that evolution in the life of the globe has run its course, and that it will not again bring forth reptiles or mammals of the terrible proportions of those of past geologic ages? nor ferns, nor mosses, nor as gigantic trees as those of Carboniferous times? Probably the redwoods of the Far West, the gigantic sequoias, are the last race of gigantic trees. The tide of life of the globe is undoubtedly at the full. The flood has no doubt been checked many times. The glacial periods, of which there seem to have been several in different parts

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of the earth, and in different geological periods, no doubt checked it when it occurred. But the tide as a whole must have steadily risen, because the progression from lower to higher forms has gone steadily forward. The lower forms have come along; Nature has left nothing behind. The radiates, the articulates, the mollusca, are still with us, but in the midst of these the higher and higher forms have been constantly appearing. The great biological tree has got its growth. Many branches and twigs have died and dropped off, and many more will do so, are doing so before our eyes, but I cannot help doubting that any new branches of importance are yet to appear — any new families or orders of birds, or fishes, or reptiles, or mammals. The horse, the stag, the sheep, the dog, the cat, as we know them, are doubtless the end of the series. One arrives at this conclusion upon general principles. Life as a whole must run its course or reach its high-water mark, the same as life in its particular phases. Man has arrived and has universal dominion; all things are put under his feet. The destiny of life upon the globe is henceforth largely in his hands. Not even he can avert the final cosmic catastrophe which physicists foresee, and which, according to Professor Lowell, the beings upon Mars are now struggling to ward off.

Man has taken his chances in the clash of forces of the physical universe. No favor has been shown

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him, or is shown him to-day, and yet he has come to his estate. He has never been coddled; fire, water, frost, gravity, hunger, death, have made and still make no exceptions in his favor. He is on a level with all other animals in this respect. He has his life and well-being on the same terms as do the fowls of the air and the beasts of the fields.

Archbishop Whately thought that primitive man could never have raised himself to a higher condition without external aid — some “elementary instruction to enable his faculties to begin their work.” He must have had a boost. Well, the boost was forthcoming, but it was not from without, but from within, through this principle of development, this upward striving that was innate from the first in certain forms of life and of which Whately had no conception. It was the conception of his time that creation was like a watch made and wound up by some power external to itself.

The physical evolution of man, as I have said, is no doubt complete. He will never have wings, or more legs, or longer arms, or a bigger brain. The wings and the extra legs and the keener sense he has left behind him. His development henceforth must be in the mental and spiritual. He is bound to have more and more dominion over Nature, and see more and more clearly his own relation to her. He will in time completely subdue and possess the earth. Yes, and probably exhaust her? But he will see in

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time that he is squandering his inheritance and will mend his ways. He will conserve in the future as he has wasted in the past. He will learn to conserve his own health. He will banish disease; he will stamp out all the plagues and scourges, through his scientific knowledge; he will double or treble the length of life. Man has undoubtedly passed through and finished certain phases of his emotional and mental development. He will never again be the religious enthusiast and fanatic he has been in the past; he has not worshiped his last, but he has worshiped his best. He will build no more cathedrals; he will burn no more martyrs at the stake. His religion as such is on the wane. But his humanitarianism is a rising tide. He is becoming less and less a savage, revolts more and more at the sight of blood and suffering. The highly religious ages were ages of blood and persecution. Man's tenderness for man has vastly increased. The sense of the sacredness of human life has increased as his faith in his gods has declined. He has grown more human as he has grown less superstitious. Science has atrophied his faith, but it has softened his heart. His fear of Nature has given place to love. Man never loved as he does now. He has withdrawn his gaze from heaven and fixed it upon the earth. As his interest in other worlds has diminished, his interest in this has increased. As the angels have departed, the children have come in.

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When the nations, too, cease to be savage and selfish, and become altruistic, then the new birth of humanity will actually have occurred. As an artist and a creator of beautiful forms, man has also had his day; he loved the beautiful, the artistic, or the ornamental long before he loved the true and the just. He was proud before he was kind; he was chivalrous before he was decent; he was tattooed before he was washed; he was painted before he was clothed; he built temples before he built a home; he sacrificed to his gods before he helped his neighbor; he was heroic before he was self-denying; he was devout before he was charitable. We are losing the savage virtues and vanities and growing in the grace of all the humanities, and this process will doubtless go on, with many interruptions and setbacks of course, till the kingdom of love is at last fairly established upon the earth.

XI

THE PHANTOMS BEHIND US

I

I TAKE the title of this paper from those great lines in Whitman beginning —

“Rise after rise bow the phantoms behind me” —

in which he launches in vivid imaginative form the whole doctrine of evolution some years before Darwin had published his epoch-making work on the “Origin of Species.”

“I see afar down the huge first Nothing, and I know I was even there.”

I do not know that Whitman had any concrete belief in the truth of the animal origin of man. He read as picture and parable that which the man of science reads as demonstrable fact. He saw and felt the great truth of evolution, but he saw it as written in his own heart and not in the great stone book of the earth, and he saw it written large. He felt its cosmic truth, its truth in relation to the whole scheme of things; he felt his own kinship with all that lives, and had a vivid personal sense of his debt to the past, not only of human history, but also to the past of the earth and the spheres. And he felt this as a poet and not as a man of science.

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The theory of evolution as applied to the whole universe and its inevitable corollary, the animal origin of man, is now well established in most of the leading minds of the world, but it is still rejected by many timid and sensitive souls, and it will be a long time before it becomes universally accepted.

Doubtless one source of the trouble we have in accepting the theory comes from the fact that our minds have not been used to such thoughts; in the mind of the race they are a new thing: they are not in the literature nor in the philosophy nor in the sacred books in which our minds have been nurtured; they are of yesterday; they came to us raw and unhallowed by the usage of ages; more than that, they savor of the materialism of all modern science, which is so distasteful to our finer ideals and religious sensibilities. In fact, these ideas are strangers of an alien race in our intellectual household, and we look upon them coldly and distrustfully. But probably to our children, or to our children's children, they will wear quite a different countenance; they will have become an accepted part of the great family of ideas of the race.

Another hindrance is the dullness and opacity of our own minds. We are slow to wake up to a sense of the divinity that hedges us about. The great office of science has been to show us this universe as much more wonderful and divine than we have been wont to believe; shot through and through with celes-

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tial laws and forces; matter, indeed, but matter informed with spirit and intelligence; the creative energy inherent and active in the ground underfoot not less than in the stars and nebulæ overhead.

We look for the divine afar off. We gaze upon the beauty and purity of the heavenly bodies without thinking that we are also in the heavens. We must open our minds to the stupendous fact that God is immanent in his universe and that it is literally and exactly true, as we were taught long ago, that, during every moment of our lives, in Him we live and move and have our being.

Moreover, we are staggered by the element of vast time that is implied in the history of development. Were it not for the records in the rocks, we could not believe it at all. All the grand movements and processes of nature are quite beyond our ken. In the heavens only the astronomer with his prisms and telescopes traces them; only the geologist and palæontologist read their history in the earth's crust. The soil we cultivate was once solid rock, but not in one lifetime, not in many lifetimes, do we see the transformation of the rocks into soil. Nations may rise and fall, and the rocks they looked upon and the soil they tilled remain practically unchanged. Geologists talk about the ancient continents that have passed away. What an abyss of time such things open! They talk about the birth of a mountain or the decay of a mountain as we talk of the birth

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and death of a man, but in doing so they reckon with periods of time for which we have no standards of measurement. They walk and talk with the Eternal. To us the mountains seem as fixed as the stars. But the stars, too, are flitting. Look at Orion some millions of years hence, and he will have been torn limb from limb. The combination of stars that forms that striking constellation and all other constellations is temporary as the grouping of the clouds. The rise of man from the lower orders implies a scale of time almost as great. It is unintelligible to us because it belongs to a category of facts that transcends our experience and the experience of the race as the interstellar spaces transcend our earthly measurements.

We now gaze upon the order below us across an impassable gulf, but that gulf we have crossed and without any supernatural means of transportation. We may say it has been bridged or filled with the humble ancestral forms that carried forward the precious evolutionary impulse of the vertebrate series till it culminated in man. All vestiges of that living bridge are now gone, and the legend of our crossing seems like a dream or a miracle. Biological evolution has gone hand in hand with geological evolution, and both are on a scale of time of which our hour-glass of the centuries gives us but a faint hint. Our notions of time are not formed on the pattern of the cosmic processes, or the geologic

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processes, or the evolutionary processes; they are formed on the pattern of our own brief span of life. In a few cases in the familiar life about us we see the evolutionary process abridged, and transformations like those of unrecorded time take place before our eyes, as when the tadpole becomes the frog or the grub becomes the butterfly. These rapid changes are analogous to those which in the depths of geologic time have evolved the bird from the fish or the reptile, or the seal and the manatee from a four-footed land animal. Our common bluebird has long been recognized as a descendant of the thrush family; this origin is evident in the speckled breast of the young birds and in the voices of the mature birds. I have heard a bluebird with an unmistakable thrush note. The transformation has doubtless been so slow that an analogous change taking place in any of the bird forms of our own time would entirely escape observation. The bluebird may have been as long in getting his blue coat as man has been in getting his upright position.

Looking into the laws and processes of the common nature about us for clues to the origin of man is not unlike looking into the records of the phonograph for the secret of the music which that wonderful instrument voices for us. Something, some active principle or agent, has to invoke the music that slumbers or is latent in these lines.

In like manner some principle or force that we

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do not see is active in the ground underfoot and in the forms of life about us which is the final secret of the origin of man and of all other creatures. This something is the evolutionary impulse, this innate aspiration of living matter to reach higher and higher forms. "Urge and urge," says Whitman, "always the procreant urge of the world." It is in Emerson's worm "striving to be man." This "striving" pervades organic nature. Whence its origin science does not assume to say.¹

Then the difference in kind between the mind of man and that of the lower orders makes evolution a doubly hard problem.

Look over the globe and see what a gulf separates man from all other creatures. All the other animals seem akin — as if the product of the same workman. Man, in contrast, seems like an introduction from some other sphere or the outcome of quite other psychological laws; his dominion over them all is so complete and universal. Without their specialization of structure or powers, he yet masters them all and uses them; without their powers of speed, he yet outstrips them; without their strength of tusk and limb, he yet subdues them; without their inerrant instinct, he yet outwits them; without their keenness of eye, ear, and nose, he yet wins in the

¹ This passage was written long before I had read Bergson's *Creative Evolution*, as were several others of the same import in this volume.

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chase; without their special adaptation to environment, he survives when they perish. A man is marked off from the animals below him, I say, as if he were a being of another sphere. He looks into their eyes and they into his, and no recognition passes; and yet we have to believe that he and they are fruit of the same biologic tree and that their stem forms unite in the same trunk somewhere in the abyss of biologic time.

The rise of man from the lower orders taxes our powers of belief and our faith in the divinity that lurks underfoot far more than did the special creation myth. Creation by omnipotent fiat seems easy when you have the omnipotent being to begin with, but creation through evolution is a kind of cosmic or biologic legerdemain that baffles and bewilders us. It so far transcends all our earthly knowledge and experience and all the flights of our philosophy that we stand speechless before it. It opens a gulf that the imagination cannot clear; it opens vistas from which we instinctively shrink; it opens up abysses of time in which our whole historic period would be but a day; it opens up a world of struggle, delay, waste, failure that palls the imagination. It challenges our faith in the immanency and in the ceaseless activity of God in his world; it brings the creative energy down from its celestial abode and clothes it with the flesh and blood of animal life. It may chill and shock us; it shows us that we are

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of the earth earthy; yea, that we are of the animal beastly; it presses us down in matter; it puts out the lights to which we have so long turned as lighting our origin; the words "sacred," "divine," "holy," and "celestial," as applied to our origin and development, we have no longer any use for, nor for any words or ideas that set us apart from the rest of creation — above it in our origin or apart from it in our relations. The atmosphere of mystery and miracle and sanctity that our religious training has thrown around our introduction upon this planet and around our relations and destiny science dispels. Our language and many of our ideas and habits of thought date back to pre-scientific times — when there were two worlds, the heavenly and the earthly, separated by a gulf. Now we know that the two worlds are one, that they are inseparably blended; that the celestial and the terrestrial are under the same law; that we can never be any more in the heavens than we are here and now, nor any nearer the final sources of life and power; that the divine is underfoot as well as overhead; that we are part and parcel of the physical universe, and take our chances in the cosmic processes the same as the rest, and draw upon the same fund of animal life that the other creatures do. We are identified with the worm underfoot no less than with the stars overhead. We are not degraded by such a thought, but the whole of creation is lifted up. Our minds and

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bodies are not less divine, but all things are more divine. We have to gird up our loins and try to summon strength to see this tremendous universe as it is, alive and divine to the last particle and embosomed in the Infinite.

II

Evolution is not the final explanation of the universe, but it is probably the largest generalization of the modern mind. Science has to start somewhere, and it starts with the universe as it finds it and seeks to trace secondary or proximate causes; the evolutionist seeks to trace the footsteps of creative energy in the world of animal life. How did God make man? Out of the dust of the earth, says the Bible of our fathers. The evolutionist teaches essentially the same thing, only he does not abridge the process as the catechism has abridged it for us; he would fain unfold the whole long road that man has traveled from the first protozoic cell to the vast communities of cells that now make up his physical life. He would show how man has risen on stepping-stones of his dead self. These stepping-stones have been the animal forms below him. In them and through them something, some impulse, some force, has mounted and mounted through all the enormous lapse of geologic time. In imagination we see the dim, shadowy man, restless and struggling in a vast number of earlier forms. He has struggled up-

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ward through the invertebrates, through the fish, through the reptile, through the lower mammals, through his simian ancestors till he reaches his goal in the man we know.

Darwin was not the author of the theory of evolution, but he made the theory alive and real to the imagination. He showed us what a master key it is for unlocking the riddle of the life of the globe. He launched biological science upon a new career and made it worthy of its place in the great trilogy of sciences, astronomy, geology, and biology, of which Tennyson, in his poem "Parnassus," recognized only the first two. Had Tennyson written his poem in our day he would undoubtedly have included biology among his "terrible Muses" that tower above all others, eclipsing the glory of the great poets. Or is it true that we find it easier to accept the theory of the evolution of the worlds and suns from nebulous matter than to accept the theory of the evolution of man from the maze of the lower animal forms? It is less personal to us. The astronomer has the advantage of the biologist in one important respect: he can show us in the heavens now the process of the evolution of worlds actually going on, but the biologist cannot show us the transformation of one species into another taking place to-day. We can sound the abysses of astronomic space easier than we can sound the abysses of geologic time. The stars and the nebulae we have

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always with us, but where are the myriad earlier forms that were the antecedents of the present animal life of the globe? True, the palæontologist finds a more or less disjointed record of them in the stratified rocks and sees in a measure the course evolution has taken, but he does not actually see it at work as does the astronomer. More than that, the forces the astronomer deals with are mechanical and chemical, but the biologist deals with a new force called life that often reverses or defies mechanical and chemical forces, but which is yet so identified and blended with them that we cannot conceive it apart from them. The stomach does not digest itself, nor gravity hold the blood in the lower extremities. The tree lifts up its weight of fluids and solids and holds aloft its fruit and foliage in spite of gravity; its growing roots split and lift the rocks; mosses and lichens disintegrate granite; vital energy triumphs over chemical and mechanical energy.

Biological laws are much more subtle and difficult to trace and formulate than chemical and mechanical laws. Hence the student of organic evolution can rarely arrive at the demonstrable certainties in this field that he can in the sphere of chemistry and mechanics. It is very doubtful if life can ever be explained in terms of these things. Life works through chemical combinations and affinities, and yet is it not more than chemistry? It works with

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and through mechanical principles and forces, and yet it is evidently more than mechanics. It is manifested through matter, and yet no analysis of matter can reveal its secret. It comes and goes while matter stays; we destroy life, but cannot destroy matter. It is as fugitive as the wind which fills all sails one minute and is gone the next. It avails itself of fluids and gases and the laws which govern them, but fluids and gases do not explain it. It waits upon the rains and the dews, but it is more than they are; it follows in the footsteps of the decay and disintegration of the inorganic, and yet it is not the gift of these things; it transforms the face of the earth, and yet the earth has been and will be when it was not and when it will not be. Through his knowledge and his science man performs wonders every day; he can reduce mountains to powder and seas to dry land, but he cannot create or start *de novo* the least throb of life. At least, he has not yet done so. With all his vast resources of mechanics and chemistry, and his insight into the mechanism of the universe, he has not yet made the least particle of inorganic matter thrill with the mysterious something we call life.

There must have been a time when life was not upon the earth and there must again come a time when it will not be. It has probably vanished from the moon and all inferior planets, and it has not yet come to the superior planets, except maybe to

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Mars. It must be and must have always been potential in matter, but this fact leaves the mystery as profound as ever.

Yet if the artificial production of life were to happen to-day — if in some of our laboratories living matter were produced from non-living, should we not still have to credit the event to some mysterious potency residing in matter itself? If by a lucky stroke man were to evoke the organic from the inorganic, be assured he would not evoke something from nothing, or add anything to the latent possibilities of the elements with which he works. Does not the question still remain who or what made this feat possible? One dare affirm that man cannot create life *de novo* any more than he can create matter. He may yet evoke life as he evokes the spark from the flint and the flame from the match or as he evokes force from the food he eats. In this latter case he does not create the force; he liberates it through the vital forces of his body. The spark from the flint and the flame from the match were called forth by a mechanical process, but the process was set going by the will which waits upon the vital process. The body with all its many functions is a complicated system of mechanical devices and chemical processes, but that which is back of all and governs all is not mechanical; the body is a machine plus something else.

The chemist or biologist who shall produce a

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speck of protoplasm to-day will have the credit of unlocking a power in inorganic nature; he will prove by a short cut how immanent the creative energy or the vital force of the universe is in matter. He will not have eliminated the creative energy; he will only have disclosed it and availed himself of it.

We behold spontaneous combustion, a fire self-kindled, but we do not see the activity of the particles of matter that preceded it or penetrate the secret of their mysterious affinities. The fire was potential there in the very constitution of the elements. We flout at miracles, and then we disclose an unending miracle in the life about us.

All the life upon the globe, including man with all his marvelous powers, surely originated upon the globe, surely arose out of the non-living and the non-thinking, not by the fiat of some power external to nature, but through the creative energy inherent in nature and ever active there. The great physical instrumentality was heat — without heat the reaction called life could never have taken place. This fact has led a French biologist to say that life is only a surface accident in the history of the thermic evolution of the globe. Without the disintegration of the rocks and the formation of the soil and the precipitation of watery vapor, which was indirectly the work of heat, the vegetable and the animal could not have developed. If we succeed in proving that all these things are of chemico-mechanical origin,

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we still want to know who or what instituted these chemical and mechanical powers and the laws that govern them. Creation by chemistry and mechanics is as mysterious as creation by miracle. We must still have a creator, while we can do nothing with him nor find any place for him in an endless, beginningless, infinite series of events. So there we are. We go out of the same door by which we came in.

When all life vanishes from the earth, as it will when the condition of heat and moisture has radically changed, and eternal refrigeration sets in — what then? The potencies of matter will not have changed and life will reappear and go through its cycle again on some other sphere.

Life began upon this earth not by miracle in the old sense, but by miracle in the new scientific sense — by the immanence and ceaseless activity of the creative energy in the physical world about us — in the sunbeam, in the rains, in the snows, in the air currents, and in the soil underfoot; in oxygen, hydrogen, carbon, nitrogen, in lime, iron, silice, phosphorus, and in all the rest of them. Each has its laws, its ways, its fixed mode of procedure, its affinities, its likes and dislikes, and life is bound up with all of them. If we hypothesize the ether to explain certain phenomena, why should we not hypothesize a vital force to account for other mysteries?

The inorganic passes into the organic as night

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passes into day. Where does one end and the other begin? No man can tell. There is no beginning and no ending of either, and yet night comes and goes and day comes and goes — a constant becoming and a constant ending. We are probably in the midday of the life of the globe — life huge and rank and riotous — the youth of life has passed, life more sedate and aspiring and spiritual has come. The gigantic has gone or is going, the huge monsters of the sea and of the land have had their day, man appears at the end of the series of lesser but more complete forms.

III

Many intelligent persons who have been rocked in the cradle of the old creeds still look upon evolution as a godless doctrine and accuse it of vulgarizing high and sacred things. This state of mind can only be slowly outgrown by familiarizing ourselves with the processes of nature or of the creative energy in the world of life and matter about us; with our own origin in the low fishlike or apelike creature in the maternal womb; with the development of every plant, tree, and animal from a microscopic germ; with the unbroken sequence of natural law; with the waste, the delays, the pains, the failures on every hand; with the impersonal and the impartial character of all the physical forces; with the transformations and metamorphoses that marked the course of animal life; and, above all, with the

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thought that evolution is not self-caused or in any true sense a cause in itself, but the instrument or plan of the power that works in and through all things. The ways of God in all these details are past finding out, but science watches the unfolding of a bud, the development of a grain of wheat, the growth of the human embryo, the succession of life-forms upon the globe as revealed in the records of the stratified rocks, or observes in the heavens the condensation of nebulous matter into suns and systems, and it says this is one of his ways. Evolution — an endless unfolding and transformation. “Urge and urge and urge,” says Whitman (I love to repeat this saying; it is so significant), “always the procreant urge of the world.” Always the labor and travail pains of the universe to bring forth higher forms; always struggle and pain and failure and death, but always a new birth and an upward reach.

Strike out the element of time and we see evolution as the great prestidigitator of the biologic ages. The creative energy manipulates a fish and it turns into a reptile; it covers a mollusk as with a vapor and behold, a backboned creature instead! Now we see a little creature no larger than a fox and when we look again, behold the horse; a wolf or some kindred animal is plunged into the water, and behold, the seal! Some small creature of the lemur kind is covered with a capacious hand, and we look

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again, and behold man! We have only to minimize time and minimize space to see the impossible happening all about us or to see the Mosaic account of creation repeated; we have only the clay and water to begin with, when, presto! behold what we have now! We see the rocks covered with verdure, the mountains vanishing into plains, the valleys changing into hills or the plains changing into mountains, tropic lands covered with ice and snow.

Lord Salisbury thought he had discredited natural selection, which is one of the feet upon which evolution goes, when he charged that no one had ever seen it at work. We have not seen it at work because our little span of life is too short. Only the palæontologist traces in the records of the rocks the footsteps of this god of change. And rarely if ever does he find a continuous and complete record — only a footprint here and there, but he sees the direction in which they are going and many of the places where the traveler tarried. The palæontologist, that detective of the rocks, works up his case with the same thoroughness and caution and the same power of observation as does the detective in human affairs and with a greater sweep of scientific imagination.

An agent of evolution is the influence of the environment, but who sees the environment set its stamp upon animal life? After many generations we may see the accumulated results. In a few in-

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stances the results are rapid. Thus sheep lose their wool in tropical climates and a northern fur-bearing animal its fur. The well-being of the animal demands this change, and demands it quickly. Fish lose their sense of sight in underground streams; this loss is not so vital and it comes about much more slowly. A tropical climate sets its stamp upon the complexion and character of man, but this again is a slow process, as the same stress of necessity does not exist.

In the tendency to variation — in form, size, disposition, power, fertility — man differs from all other animals. In the same race, in the same family, we find infinitely varied types. Among the wild creatures all the individuals of a species are practically alike. We can hardly tell one fox, or one marmot, or one chipmunk, or one crow, or one hawk, or one black duck from another of the same species. Of course there are slight individual differences, but they are hardly distinguishable. Among the insects, one bee, one beetle, one ant, one butterfly seems the exact copy of every other individual of its kind. The law of variation seems practically annulled in the insect world.

It is the wide and free range of this law in the human species that has undoubtedly led to the great progress of the race. There has been no dead level — no democracy of talent — no equality of gifts, but only equality of opportunity. Men differ

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from one another in their mental endowments, capacities, and dispositions vastly more than do any other creatures upon the earth. This difference makes man's chances of progress so much the greater; he has so many more stakes in the game. If one type of talent fails, another type may win; if the lymphatic temperament is not a success, try the sanguine or the bilious; blue eyes and black eyes and brown eyes will win more triumphs than blue or black or brown alone. Arms or legs extra long, sight or hearing extra sharp, wit extra keen, judgment extra sure — all these things open doors to more progress. Variation gives natural selection a chance to take hold, and where the struggle for life is the most severe the changes will be the most rapid and the most radical. Without the pressure of the environment natural selection would not select. The tendency to physical variation in man is probably no greater than in other creatures, but his tendency to mental variation is enormous. He varies daily from mediocrity to genius, hence the enormous range of his chances of progress. From the first variation that started him on his way in his line of descent, variation must have been more and more active till he varied in the direction of reason, long before the dawn of history, since which time his progress has been by rapid strides — and more and more rapid till we see his leaps forward in recent times. The race owes its rapid progress to

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its exceptional men, its men of genius and power, and these have often been like sports or the sudden result of mutations — a man like Lincoln springing from the humblest parentage. No such extreme variations are seen in any of the lower orders. Indeed, in one's lifetime one sees but very slight variation in any of the wild or domestic creatures, less in the wild than in the domestic because they are less under the influence of that most variable of animals, man. And man's variations are mainly mental and not physical. The higher we go in the scale of powers, the greater the variation and hence the more rapid the evolution. Probably man's body has not changed radically in vast cycles of time, but his mind has developed enormously since the dawn of history.

IV

Biologists are coming more and more to recognize some unknown factor in evolution, probably some unknowable factor. The four factors of Osborn — heredity, ontogeny, environment, selection — play upon and modify endlessly the new form when it is started, but what about the original start? Whence comes this inborn momentum, this evolutionary send-off? What or who set the whole grand process going?

Bergson sees an internal psychological principle of development, hence the name of his book, "Creative Evolution." Osborn uses the word "directed."

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Certain characters, he says, are adaptive or suited to their purpose from the start; they do not have to be fitted to their place by natural selection. Huxley uses the word "predestined" — all the life of the globe and all the starry hosts of heaven are working out in boundless space and in endless time "their predestined course of evolution." Darwin must have had in mind the same mysterious something when he said that man had risen to the very summit of the animal scale, but not through his own exertions. Not by his own will or exertion, surely, any more than the embryo in its mother's womb develops into the full-grown child by its own exertion or than our temperaments and complexions and statures are matters of our own wills and choice. Something greater than man and before him, to which he sustains the relation that the unborn child sustains to its mother, must enter into our thought of his origin and development.

The great evolutionists have been very cautious about seeking to go behind evolution and name the Primal Cause. In such an attempt science would at once be beyond soundings. Darwin and Huxley were reverent, truth-loving men, but they hesitated as men of science to put themselves in a position where no step could be taken.

Slowly man emerges out of the abyss of geologic time into the dawn of history, and science gropes about like a man feeling his way in the dark or, at

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most, by the aid now and then of a dim flash of light, to trace the path he has come. He has surely arrived, and we are, I believe, safe in saying he has come by the way of the lower orders; but the precise forms through which he has come, the houses in which he has tarried by the way, and all the adventures and vicissitudes that befell him on the journey — can we ever hope to know these things? In any case, man has his antecedents; life has its antecedents; every beat of one's heart has its antecedent cause, which again has its antecedent. We can thus traverse the chain of causation only to find it is an endless chain; the separate links we can examine, but the first link or the last we see, by the very nature of things, and the laws of our own minds, must forever elude us. Science cannot admit of a break in the chain of causation, cannot admit that miracles or the supernatural in the old sense, as external and arbitrary interference with the natural order, can play or ever have played any part in this universe. Yet science has to postulate a First Cause when it knows, or metaphysics knows for it, that with the Infinite there can be no first and no last, no beginning and no ending, only endless succession.

To science man is not a fallen creature, but a many times risen creature and all the good of the universe centres in him. The mind that pervades all nature and is active in plant and animal alike first comes to know itself and regard itself and

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achieve intellectual appreciation in man. While all nature below man is wise only to its own ends and goes its appointed way as void of self-consciousness as the stone that falls or the wind that blows, the mind of man attains to disinterested wisdom and turns upon itself and upon the universe the power of objective thought; it alone achieves understanding.

In our studies of life and of the universe as soon as we begin to bridge chasms by an appeal to the miraculous, or to the extra-natural powers, we are traitors to the scientific spirit which we seek to serve. There are many things that science cannot explain. Perhaps I may say that it cannot give the ultimate explanation of anything. It can do little more than tell us of the action, the interaction, and the reaction of things, but of the things themselves, their origin and ultimate nature, or the source of the laws that govern them, what does it or what can it know?

Man is the heir of all the geologic ages; he inherits the earth after countless generations of animals and plants, and the beneficent forces of wind and rain, air and sky, have in the course of millions of years prepared it for him. His body has been built for him through the lives and struggles of the countless beings who are in the line of his long descent; his mind is equally an accumulated inheritance of the mental growth of the myriads of thinking men and unthinking animals that went before him. In the

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forms of his humbler forebears he has himself lived and died myriads of times to make ready the soil that nurses and sustains him to-day. He is a debtor to Cambrian and Silurian times, to the dragons and saurians and mastodons that have roamed over the earth. Indeed, what is there or has there been in the universe that he is not indebted to? The remotest star that shines has sent a ray that has entered into his life. All things are under his feet, and the keys of the heavens are in his hands.

V

One would fain arrive at some concrete belief or image of his line of descent in geologic time as he does in the historic period. But how hard it is to do so! Can we form any mental picture of the actual animal forms that the manward impulse has traveled through? With all the light that palæontology throws upon the animal life of the past, can we see where amid the revel of these bizarre forms our ancestor hid himself? Can we see him as a reptile in the slime of the jungle or in the waters of the Mesozoic world? What was he like or what akin to? What mark or sign was there upon him at that time of the future that was before him? Can we see him as a fish in the old Devonian seas or lakes? Was he a big fish or a little fish? The primitive fishes were mostly of the shark kind. Is there any connection between that fact and the human sharks of

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to-day? Much less can one picture to one's self what his ancestor was like in the age of the invertebrates, amid the trilobites, etc., of the earlier Palæozoic seas. But we must go back even earlier than that, back to unicellular life and to original protoplasm, and finally back to fiery nebulous matter. What can we make of it all by way of concrete conception of what actually took place — of the visible, eating, warring, breeding animal forms in whose safekeeping our heritage lay? Nothing. We are not merely at sea, we are in abysmal depths, and the darkness is so thick we can cut it.

We meet the same difficulty when we try to figure to ourselves the line of descent of any of the animal forms of to-day. How did they escape the world-wild catastrophe of earlier geologic times? Or did the creative impulse bank upon life as a whole and never become bankrupt, no matter what special lines or forms failed?

The first appearance of the primates is in Eocene times and the anthropoid apes in the Miocene, probably five millions of years ago. The form which may have been in our line of descent, the *Dryopithecus*, later appears to have become extinct. Did our fate hang upon the success of any of these forms? The monkeys and anthropoid apes appeared at the same time in different countries. Nature seems to have been making preliminary studies of man in these various forms, but when and where she hit

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upon the form that she perfected in man, who knows?

The horse appears to have been evolved in North America, true cattle in Asia, elephants in Africa. Can we narrow their line of descent down to a single pair for each? Many forms allied to the horse appeared in Europe and Asia in Miocene times. We find monkeys in different parts of the world in the same geologic horizons; did they all have a common origin?

Life's apprenticeship has been a long one. The earlier forms of vertebrate life were very large; later they became very small. Nature seems to have experimented with bulk, as if she thought size would win in the race. Hence those huge uncouth forms among the reptiles and early mammals. The scheme did not work well; bulk was not the thing, after all. Most of the gigantic forms became extinct. Then she tried smaller and more agile forms with larger brains — less flesh and more wit. On this line Nature continued to work till she produced her masterpiece in man — a rather feeble and nearly weaponless animal, but with an intangible armory of weapons and tools in his brain that enables him to put all creatures under his feet.

XII

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I

BERGSON, the new French philosopher, thinks we all had a narrow escape, back in geologic time, of having our eggs spoiled before they were hatched, or, rather, rendered incapable of hatching by too thick a shell. This was owing to the voracity of the early organisms. As they became more and more mobile, they began to take on thick armors and breastplates and shells and calcareous skins to protect themselves from one another. This tendency resulted, he thinks, in the arrest of the entire animal world in its evolution toward higher and higher forms. These shells and armors begat a kind of torpor and immobility which has continued down to our day with the echinoderms and mollusks, but the arthropods and vertebrates escaped it by some lucky stroke. Now you and I are here without imprisoning shells on our backs; but how or why did we escape? Bergson does not say. Was it a matter of luck or chance? Was there ever a time when the stream of life tended to harden and become fixed in its own forms like a stream of cooling lava, or has the innate plasticity

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of life been easily equal to its own ends? True; the clam remains a clam, and the starfish remains a starfish; some other forms have carried the evolutionary impulse forward till it flowered in man. Was this impulse ever really checked or endangered? Was the golden secret ever intrusted to the keeping of any single form? and, had that form been cut off, would the earth have been still without its man? These are puzzling questions.

Thus, when we have come to look upon life and nature in the light of evolution, what vistas are opened to us where before were only blank walls! The geologic ages take on a new interest to us. We know that in some form we were even there. The systems of sedimentary rocks which the geologist portrays, piled one upon the other to a depth of fifty miles or more, seem like the stairway by which we have ascended, taking on some new and more developed form at each rise. What we were at the first step in Cambrian times only the Lord knows, but whatever we were, we crept up or floated up to the next rise. In the Silurian seas we may have been a trilobite for aught we know; at any rate, we were the outcome of the life impulse that begat the trilobites, but our fate was not bound up with theirs, as their race came to an end in those early geologic ages, and our stem form did not. Whether or not we were a fish in the Devonian seas, there is little doubt that we had gills, because we have the gill-

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slits yet in our early foetal life, and it is quite certain that in some way we owe our backbones to the fishes.

When the rocks that form my native Catskills were being laid down in the Devonian waters, I fancy that my aquatic embryo was swimming about somewhere and slowly waxing strong. Up and up I climbed across the sandstone steps, across the limestone, the conglomerate, the slate, up into Carboniferous times. The upper and nether millstones of the "millstone grit" did not crush me, neither did the floods and the convulsions of Carboniferous times that buried the vast vegetable growths that resulted in our coal measures engulf or destroy me. About that time probably, I emerged from the water and became an amphibian, and maybe got my five fingers and five toes on each side.

Nor did the wholesale destruction of animal life at the end of Palæozoic time cut off my line of descent. The monstrous reptiles of the succeeding or Mesozoic age, the petrified remains of one of which was recently found in the sandstone rocks near the river's edge under the Palisades of the Hudson, do not seem to have endangered the golden thread by which our fate hung. Still "I mount and mount." The stairs by which I climb were rent by earthquakes and volcanoes, the strata were squeezed up and overturned and folded in the great mountain-chains; the Alps, the Andes, the Himalayas, the Coast Range were born; the earth-throes must have

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been tremendous at times; yet I escaped it all. The huge and fearful mammals of the third or Tertiary period passed me by unharmed. Eruptions and cataclysms, the sinking of the land, the inundations of the sea, world-wide deformations of the earth's crust, fire and ice and floods, monsters of the deep and dragons of the land and the air have beset my course from the first, and yet here I am, here we all are, and apparently none the worse for the appalling dangers we have passed through.

Evolution thus makes the world over for us. It shows us in what a complex web of vital and far-reaching relations we stand. It gives us an outlook upon the past that is startling, and in some ways forbidding, yet one that ought to be stimulating and inspiring. If we look back with a shudder we should look forward with a thrill. If the past is terrible, the future is in the same degree cheering and inviting. If we came out of those lowly and groveling forms, to what heights of being may we not be carried by the impetus that brought us thus far? In fact, to what heights has it already carried us!

II

That the hazards of the past, to many forms of life, at least, have been real and no myth, is evident from the vast number of forms that have been cut off and become extinct; various causes, now hard to decipher, have worked together to the end, such

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as changed geographical conditions, changes of climate, affecting the food-supply, extreme specialization, like that of the sabre-toothed tiger whose petrified remains have been found in various parts of this continent, and who apparently was finally handicapped by his huge dental sabre. Probably many more species of animals have become extinct than have survived, but none of these could have been in the line of man's descent, else the human race would not have been here. If the Eocene progenitor of the horse, the little four-toed eohippus, had been cut off, would not the world have been horseless to-day? The horse in America became extinct, from some cause only conjectural, many tens of thousands of years ago. Had the same fate befallen the horse in Europe and Asia, it seems probable that our civilization would have been far less advanced to-day than it is.

The fate of every species of mammal in our time seems to have been in the keeping of a single form in early Tertiary times. The end of the Cretaceous or chalk period saw the extinction of the giant reptiles both of sea and of land, at the same time that it saw the appearance of a great many species of small and inconspicuous mammals, among which doubtless were our own humble forebears. Extreme specialization in any direction may narrow an animal's chances of survival; they have but one chance in the game of life, whereas an animal with a more

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generalized organization has many chances. Man is one of the most generalized of animals; no special tools, no special weapons — his hand many tools and weapons in one. Hence he is the most adaptable of animals; all climes, all foods, all places are his; he is master of the land, of the sea, of the air.

Animal life is often curiously interdependent. I asked our guide in the Adirondacks if there were any ravens there. "Not nearly as many as there used to be," he said, and his explanation of their disappearance seems thoroughly scientific; it was that the wolves and the panthers kept them in meat, and now that these animals had disappeared, the ravens had little to feed upon. If the moose were compelled to graze from off the ground, like a sheep or a cow, the species would probably soon become extinct. Osborn thinks it probable that the huge beast called titanotherium finally became extinct early in Tertiary times owing to the form of its teeth, which were of such a type that they could not change to meet a change in the flora upon which the creature fed. Of course we shall never know what narrow escapes our race had from extinction in the remote past; some forms have ended in a blind alley, like the sea-urchin and the oyster. Arthropoda have continued to evolve and have reached their high-water mark of intelligence in bees and ants. The vertebrates went forward and have culminated in man. Bergson thinks that in the vertebrates intelli-

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ligence has been developed at the expense of instinct, and that in the invertebrates instinct has been perfected at the expense of intelligence.

Are we not compelled to adopt what is called the monophyletic hypothesis, that is, that our line of descent started from one pair, male and female, somewhere in the vast stretch of geologic or biologic time, and to reason that, had that pair been out of the race, we should not have appeared?

Can we narrow life to a single point, a single cell, in the past? Was there one and only one first bit of protoplasm? If we were to say that life first appeared on the globe in Cambrian times, just what should we mean? That it began as a single point, or as many points? When we say that the primates first appeared in Eocene times, do we mean that one single primate appeared then? If so, what form went immediately before him? This is all a vain speculation.

Does man presuppose all the vertebrate sub-kingdom? Was he safe as long as one vertebrate form remained? Are his forebears many, and not one pair? Can we think of his ancestry under the image of a tree, and of him as one of the many branches? If so, nothing but the destruction of the tree would have imperiled his appearance, or the lopping off of his particular branch. Probably all such images are misleading. We simply cannot figure to ourselves the tangled course of our biological descent. If

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thwartings and accidents and delays could have cut man off, how could he have escaped? We cannot think of man as one; we are compelled to think of him as many; and yet in all our experience the many come from the one, or the one pair.

How thick the field of animal life in the past is strewn with extinct forms! — as thick as the sidereal spaces are strewn with the fragments of wrecked worlds! But other worlds and suns are spun out of the wrecked worlds and suns through the process of cosmic evolution. The world-stuff is worked over and over. Extinct animal forms must have given rise to other, allied forms before they perished, and these to still others, and so on down to our time.

The image of a tree is misleading from the fact that all the different branches of the animal kingdom, from the protozoa up to man, have come along with what we call the higher branches, the mammals; the suckers have kept pace with the main stalk, so that we have the image of a sheaf of branches starting from a common origin and all of equal length. Man has brought on his relations along with him.

There is no glamour of romance over that past. It was all hard, prosy, terrible fact. The earth's crust was less stable than now, the upheavals and subsidences and earthquakes more frequent, the warring of the elements more fierce and incessant, deluge and inundation in more rapid succession, and

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the riot and excesses of animal life far beyond anything we know of. And our line of descent was taking its chances amid it all. The widespread blotting out of life at the end of Palæozoic time, and again at the end of Mesozoic times, when myriads of forms were cut off, probably from some convulsion of nature or some cosmic catastrophe; and again during the ice age, when the camel, the llama, the horse, the tapir, the mastodon, the elephant, the giant sloth, became extinct in North America — how fared it with our ancestor during these terrible ages? There is no sure trace of him till late Tertiary times, and it is probably not more than two hundred thousand years ago that he assumed the upright attitude and began to use tools. Probably in Europe fifty thousand years ago he was living in caves, clothed in skins, contending with the cave bear and cave lion, using rude stone implements, and hunting the hairy mastodon, etc. In Asia the probabilities are that he was farther on the road toward the dawn of history.

We may think of our descent in the historic period under the image of the stream, though of a stream many times delayed and diverted, even many times diminished by wars and plagues and famine, but a stream with some sort of unity and continuity, since man became man. The stream of life is like any other stream in this respect. Divert or use up part

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of the water of a stream, yet what is left flows on and keeps up the continuity and identity of the stream; dip your cup into it here, and you will not get precisely the same water you would have got had none of it been diverted or used far back in its course — you get the water that was allowed to flow by.

Had there been no loss of life by war and pestilence and accidents of various kinds, the different countries would have been occupied by quite other men and women than those that fill them to-day. The course of life in every neighborhood is changed by what seem like accidental causes, as when a family is practically wiped out by some accident or dread disease. This brings new people on the scene. The farm or the business falls into other hands, and new social relations spring up, new men and women are brought together or the old ones driven apart, marriage is hastened or retarded, opportunities for family life are made or unmade, and fewer children, or more children, as the case may be, are the result. The issue of some battle hundreds or thousands of years ago may have played a part in your life and mine to-day — other races, other individuals of the race, would have been thrown together had the issue been different, and other families started, so that some one else would have been here in our stead.

But the question of hazard to the race of man in geologic time is quite a different one. Here our fate

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seems to hang by a single thread—a golden thread, we may call it, but, in that terrible maze of clashing forces and devouring forms of the vast geologic periods, how liable to be broken! It is not now a question of the continuity of a stream, but of the continuity of a single evolutionary process, or, as Haeckel says, the continuity of the morphological chain which stretches from the lemurs up through tailed and tailless anthropoid apes to man. If the evolutionary impulse had been checked or extinguished in the lemur—that small apelike animal that went before the true ape, the fossil remains of which have been found on this continent and the survivals of which are now found in Madagascar—would man have appeared? Again, if the race of lemurs developed from a single pair, how precarious seems our fate! In fact, if any of the transitional forms between species can be reduced to a single pair—as the forms that connect the reptiles with the mammals—our fate would seem to be in the keeping of these forms. Over this single frail bridge which escaped the floods and the tornadoes and the earthquakes of those terrible ages we must have passed. What risky business it all seems! Was it luck or law that favored us? Doubtless, if we could penetrate the mystery, we should see that there was no chance or risk in the matter. We cannot go very far in solving these great fundamental questions by applying to them the tests of our own experience.

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Numberless specific forms become extinct, but the impulse that begat the form does not die out. Thus, all the giant reptiles died out — the dinosaurs, the mesosaurs — but the reptilian impulse still survives. How many types of invertebrates have perished! but the invertebrate impulse still goes on. How many species of mammals have been cut off! yet the mammal impulse has steadily gone forward. These things suggest the wave that moves on but leaves the water behind. The vertebrate impulse began in wormlike forms, in the old Palæozoic seas, and stopped not till it culminated in man. This impulse has left many forms behind it; but has this impulse itself ever been endangered? If one looks at the matter thus in an abstract instead of a concrete way, the problem of our descent becomes easier.

When we look at the evolution of life on a grand scale, nature seems to feel her way, like a blind man, groping, hesitating, trying this road and then that. In some cases the line of evolution seems to end in a *cul de sac* beyond which no progress is possible. The forms thus cornered soon become extinct. The mystery, the unaccountable thing, is the appearance of new characters. The slow modification or transformation of an existing character may often be traced; natural selection, or the struggle for existence, takes it in hand and adapts and perpetuates it, or else eliminates it. But the origin of certain new parts or characters — that is the secret of the evolu-

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tionary process. Thus there was a time when no animal had horns; then horns appeared. "In the great quadruped known as titanotherium," says Osborn, "rudiments of horns first arise independently at certain definite parts of the skull; they arise at first alike in both sexes, or asexually; then they become sexual, or chiefly characteristic of males; then they rapidly evolve in the males while being arrested in development in the females; finally, they become in some of the animals dominant characteristics to which all others bend." Nature seems to throw out these new characters and then lets them take their chances in the clash of forces and tendencies that go on in the arena of life. If they serve a purpose or are an advantage, they remain; if not, they drop out. Nature feels her way. The horns proved of less advantage to the females than to the males; they seem a part of the plus or overflow of the male principle, like the beard in man — the badge of masculinity. The titanotherium is traceable back to a hornless animal the size of a sheep, and it ended in a horned quadruped nearly as large as an elephant. It flourished in Wyoming in early Tertiary times. Nature did not seem to know what to do with horns when she first got them. She played with them like a child with a new toy. Thus she gave two pairs to several species of mammals, one pair on the nose and one pair on the top of the skull — certainly an embarrassment of weapons.

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The first horns appear to have been crude, heavy, uncouth, but long before we reach our own geologic era they appear in various species of quadrupeds, and become graceful and ornamental. How beautiful they are in many of the African antelope tribe! Nature's workmanship nearly always improves with time, like that of man's, and sooner or later takes on an ornamental phase.

The early uncouth, bizarre forms seem to be the result of the excess or surplus of life. Life in remote biologic times was rank and riotous, as it is now, in a measure, in tropical lands. One reason may be that the climate of the globe during the middle period, and well into the third period, appears to have been of a tropical character. The climatic and seasonal divisions were not at all pronounced, and both animal and vegetable life took on gigantic and grotesque forms. In the ugliness of alligator and rhinoceros and hippopotamus of our day we get some hint of what early reptilian and mammalian life was like.

That Nature should have turned out better and better handiwork as the ages passed; that she either should have improved upon every model or else discarded it; that she should have progressed from the bird, half-dragon, to the sweet songsters of our day and to the superb forms of the air that we know; that evolution should have entered upon a refining and spiritualizing phase, developing larger brains

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and smaller bodies, is a very significant fact, and one quite beyond the range of the mechanistic conception of life.

Our own immediate line of descent leads down through the minor forms of Tertiary and Mesozoic times — forms that probably skulked and dodged about amid the terrible and gigantic creatures of those ages as the small game of to-day hide and flee from the presence of their arch-enemy, man; and that the frail line upon which the fate of the human race hung should not have been severed during the wild turmoil of those ages is, to me, a source of perpetual wonder.

III

The hazards of the future of the race must be quite different from those I have been considering. They are the hazards incident to an exceptional being upon this earth — a being that takes his fate in his own hands in a sense that no other creature does.

Man has partaken of the fruit of the Tree of Good and Evil, which all the lower orders have escaped. He knows, and knows that he knows. Will this knowledge, through the opposition in which it places him to elemental nature and the vast system of artificial things with which it has enabled him to surround himself, cut short his history upon this planet? Will Nature in the end be avenged for the secrets he has forced from her? His civilization has

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doubtless made him the victim of diseases to which the lower orders, and even savage man, are strangers. Will not these diseases increase as his life becomes more and more complex and artificial? Will he go on extending his mastery over Nature and refining or suppressing his natural appetites till his original hold upon life is fatally enfeebled?

It seems as though science ought to save man and prolong his stay on this planet, — it ought to bring him natural salvation, as his religion promises him supernatural salvation. But of course, man's fate is bound up with the fate of the planet and of the biological tree of which he is one of the shoots. Biology is rooted in geology. The higher forms of life did not arbitrarily appear, they flowed out of conditions that were long in maturing; they flowered in season, and the flower will fall in season. Man could not have appeared earlier than he did, nor later than he did; he came out of what went before, and he will go out with what comes after. His coming was natural, and his going will be natural. His period had a beginning, and it will have an end. Natural philosophy leads one to affirm this; but of time measured by human history he may yet have a lease of tens of thousands of years.

The hazard of the future is a question of both astronomy and geology. That there are cosmic dangers, though infinitely remote, every astronomer knows. That there are collisions between heavenly

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bodies is an indubitable fact, and if collisions do happen to any, allow time enough and they must happen to all. That there are geologic dangers through the shifting and crumpling of the earth's crust, every geologist knows, though probably none that could wipe out the whole race of man. The biologic dangers of the past we have outlived — the dangers that must have beset a single line of descent amid the carnival of power and the ferocity of the monster reptiles of Mesozoic times, and the wholesale extinction of species that occurred in different geologic periods.

Nothing but a cosmic catastrophe, involving the fate of the whole earth, could now exterminate the human race. It is highly improbable that this will ever happen. The race of man will go out from a slow, insensible failure, through the aging of the planet, of the conditions of life that brought man here. The evolutionary process upon a cooling world must, after the elapse of a vast period of time, lose its impetus and cease.

XIII

THE GOSPEL OF NATURE

I

THE other day a clergyman who described himself as a preacher of the gospel of Christ wrote, asking me to come and talk to his people on the gospel of Nature. The request set me to thinking whether or not Nature has any gospel in the sense the clergyman had in mind, any message that is likely to be specially comforting to the average orthodox religious person. I suppose the parson wished me to tell his flock what I had found in Nature that was a strength or a solace to myself.

What had all my many years of journeyings to Nature yielded me that would supplement or reinforce the gospel he was preaching? Had the birds taught me any valuable lessons? Had the four-footed beasts? Had the insects? Had the flowers, the trees, the soil, the coming and the going of the seasons? Had I really found sermons in stones, books in running brooks and good in everything? Had the lilies of the field, that neither toil nor spin, and yet are more royally clad than Solomon in all his glory, helped me in any way to clothe myself with humility, with justice, with truthfulness?

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It is not easy for one to say just what he owes to all these things. Natural influences work indirectly as well as directly; they work upon the subconscious, as well as upon the conscious, self. That I am a saner, healthier, more contented man, with truer standards of life, for all my loiterings in the fields and woods, I am fully convinced.

That I am less social, less interested in my neighbors and in the body politic, more inclined to shirk civic and social responsibilities and to stop my ears against the brawling of the reformers, is perhaps equally true.

One thing is certain, in a hygienic way I owe much to my excursions to Nature. They have helped to clothe me with health, if not with humility; they have helped sharpen and attune all my senses; they have kept my eyes in such good trim that they have not failed me for one moment during all the seventy-five years I have had them; they have made my sense of smell so keen that I have much pleasure in the wild, open-air perfumes, especially in the spring — the delicate breath of the blooming elms and maples and willows, the breath of the woods, of the pastures, of the shore. This keen, healthy sense of smell has made me abhor tobacco and flee from close rooms, and put the stench of cities behind me. I fancy that this whole world of wild, natural perfumes is lost to the tobacco-user and to the city-dweller. Senses trained in the open air are in tune

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with open-air objects; they are quick, delicate, and discriminating. When I go to town, my ear suffers as well as my nose: the impact of the city upon my senses is hard and dissonant; the ear is stunned, the nose is outraged, and the eye is confused. When I come back, I go to Nature to be soothed and healed, and to have my senses put in tune once more. I know that, as a rule, country or farming folk are not remarkable for the delicacy of their senses, but this is owing mainly to the benumbing and brutalizing effect of continued hard labor. It is their minds more than their bodies that suffer.

When I have dwelt in cities the country was always near by, and I used to get a bite of country soil at least once a week to keep my system normal.

Emerson says that "the day does not seem wholly profane in which we have given heed to some natural object." If Emerson had stopped to qualify his remark, he would have added, if we give heed to it in the right spirit, if we give heed to it as a nature-lover and truth-seeker. Nature love as Emerson knew it, and as Wordsworth knew it, and as any of the choicer spirits of our time have known it, has distinctly a religious value. It does not come to a man or a woman who is wholly absorbed in selfish or worldly or material ends. Except ye become in a measure as little children, ye cannot enter the kingdom of Nature — as Audubon entered it, as Tho-

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reau entered it, as Bryant and Amiel entered it, and as all those enter it who make it a resource in their lives and an instrument of their culture. The forms and creeds of religion change, but the sentiment of religion—the wonder and reverence and love we feel in the presence of the inscrutable universe—persists. Indeed, these seem to be renewing their life to-day in this growing love for all natural objects and in this increasing tenderness toward all forms of life. If we do not go to church so much as did our fathers, we go to the woods much more, and are much more inclined to make a temple of them than they were.

We now use the word Nature very much as our fathers used the word God, and, I suppose, back of it all we mean the power that is everywhere present and active, and in whose lap the visible universe is held and nourished. It is a power that we can see and touch and hear, and realize every moment of our lives how absolutely we are dependent upon it. There are no atheists or skeptics in regard to this power. All men see how literally we are its children, and all men learn how swift and sure is the penalty of disobedience to its commands.

Our associations with Nature vulgarize it and rob it of its divinity. When we come to see that the celestial and the terrestrial are one, that time and eternity are one, that mind and matter are one, that death and life are one, that there is and can be no-

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thing not inherent in Nature, then we no longer look for or expect a far-off, unknown God.

Nature teaches more than she preaches. There are no sermons in stones. It is easier to get a spark out of a stone than a moral. Even when it contains a fossil, it teaches history rather than morals. It comes down from the fore-world an undigested bit that has resisted the tooth and maw of time, and can tell you many things if you have the eye to read them. The soil upon which it lies or in which it is imbedded was rock, too, back in geologic time, but the mill that ground it up passed the fragment of stone through without entirely reducing it. Very likely it is made up of the minute remains of innumerable tiny creatures that lived and died in the ancient seas. Very likely it was torn from its parent rock and brought to the place where it now lies by the great ice-flood that many tens of thousands of years ago crept slowly but irresistibly down out of the North over the greater part of all the northern continents.

But all this appeals to the intellect, and contains no lesson for the moral nature. If we are to find sermons in stones, we are to look for them in the relations of the stones to other things — when they are out of place, when they press down the grass or the flowers, or impede the plow, or dull the scythe, or usurp the soil, or shelter vermin, as do old institutions and old usages that have had their day. A

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stone that is much knocked about gets its sharp angles worn off, as do men. "A rolling stone gathers no moss," which is not bad for the stone, as moss hastens decay. "Killing two birds with one stone" is a bad saying, because it reminds boys to stone the birds, which is bad for both boys and birds. But "People who live in glass houses should not throw stones" is on the right side of the account, as it discourages stone-throwing and reminds us that we are no better than our neighbors.

The lesson in running brooks is that motion is a great purifier and health-producer. When the brook ceases to run, it soon stagnates. It keeps in touch with the great vital currents when it is in motion, and unites with other brooks to help make the river. In motion it soon leaves all mud and sediment behind. Do not proper work and the exercise of will power have the same effect upon our lives?

The other day in my walk I came upon a sap-bucket that had been left standing by the maple tree all the spring and summer. What a bucketful of corruption was that, a mixture of sap and rain-water that had rotted, and smelled to heaven. Mice and birds and insects had been drowned in it, and added to its unsavory character. It was a bit of Nature cut off from the vitalizing and purifying chemistry of the whole. With what satisfaction I emptied it upon the ground while I held my nose and saw it filter into the turf, where I knew it was dying

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to go and where I knew every particle of the reeking, fetid fluid would soon be made sweet and wholesome again by the chemistry of the soil!

II

I am not always in sympathy with nature-study as pursued in the schools, as if this kingdom could be carried by assault. Such study is too cold, too special, too mechanical; it is likely to rub the bloom off Nature. It lacks soul and emotion; it misses the accessories of the open air and its exhilarations, the sky, the clouds, the landscape, and the currents of life that pulse everywhere.

I myself have never made a dead set at studying Nature with note-book and field-glass in hand. I have rather visited with her. We have walked together or sat down together, and our intimacy grows with the seasons. What I have learned about her ways I have learned easily, almost unconsciously, while fishing or camping or idling about. My desultory habits have their disadvantages, no doubt, but they have their advantages also. A too strenuous pursuit defeats itself. In the fields and woods more than anywhere else all things come to those who wait, because all things are on the move, and are sure sooner or later to come your way.

To absorb a thing is better than to learn it, and we absorb what we enjoy. We learn things at school, we absorb them in the fields and woods and

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on the farm. When we look upon Nature with fondness and appreciation she meets us halfway and takes a deeper hold upon us than when studiously conned. Hence I say the way of knowledge of Nature is the way of love and enjoyment, and is more surely found in the open air than in the school-room or the laboratory. The other day I saw a lot of college girls dissecting cats and making diagrams of the circulation and muscle-attachments, and I thought it pretty poor business unless the girls were taking a course in comparative anatomy with a view to some occupation in life. What is the moral and intellectual value of this kind of knowledge to those girls? Biology is, no doubt, a great science in the hands of great men, but it is not for all. I myself have got along very well without it. I am sure I can learn more of what I want to know from a kitten on my knee than from the carcass of a cat in the laboratory. Darwin spent eight years dissecting barnacles; but he was Darwin, and did not stop at barnacles, as these college girls are pretty sure to stop at cats. He dissected and put together again in his mental laboratory the whole system of animal life, and the upshot of his work was a tremendous gain to our understanding of the universe.

I would rather see the girls in the fields and woods studying and enjoying living nature, training their eyes to see correctly and their hearts to respond intelligently. What is knowledge without enjoy-

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ment, without love? It is sympathy, appreciation, emotional experience, which refine and elevate and breathe into exact knowledge the breath of life. My own interest is in living nature as it moves and flourishes about me winter and summer.

I know it is one thing to go forth as a nature-lover, and quite another to go forth in a spirit of cold, calculating, exact science. I call myself a nature-lover and not a scientific naturalist. All that science has to tell me is welcome, is, indeed, eagerly sought for. I must know as well as feel. I am not merely contented, like Wordsworth's poet, to enjoy what others understand. I must understand also; but above all things I must enjoy. How much of my enjoyment springs from my knowledge I do not know. The joy of knowing is very great; the delight of picking up the threads of meaning here and there, and following them through the maze of confusing facts, I know well. When I hear the woodpecker drumming on a dry limb in spring or the grouse drumming in the woods, and know what it is all for, why, that knowledge, I suppose, is part of my enjoyment. The other part is the associations that those sounds call up as voicing the arrival of spring: they are the drums that lead the joyous procession.

To enjoy understandingly, that, I fancy, is the great thing to be desired. When I see the large ichneumon-fly, *Thalessa*, making a loop over her back with her long ovipositor and drilling a hole in

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the trunk of a tree, I do not fully appreciate the spectacle till I know she is feeling for the burrow of a tree-borer, *Tremex*, upon the larvæ of which her own young feed. She must survey her territory like an oil-digger and calculate where she is likely to strike oil, which in her case is the burrow of her host *Tremex*. There is a vast series of facts in natural history like this that are of little interest until we understand them. They are like the outside of a book which may attract us, but which can mean little to us until we have opened and perused its pages.

The nature-lover is not looking for mere facts, but for meanings, for something he can translate into the terms of his own life. He wants facts, but significant facts — luminous facts that throw light upon the ways of animate and inanimate nature. A bird picking up crumbs from my window-sill does not mean much to me. It is a pleasing sight and touches a tender cord, but it does not add much to my knowledge of bird-life. But when I see a bird pecking and fluttering angrily at my window-pane, as I now and then do in spring, apparently under violent pressure to get in, I am witnessing a significant comedy in bird-life, one that illustrates the limits of animal instinct. The bird takes its own reflected image in the glass for a hated rival, and is bent on demolishing it. Let the assaulting bird get a glimpse of the inside of the empty room through

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a broken pane, and it is none the wiser; it returns to the assault as vigorously as ever.

The fossils in the rocks did not mean much to the earlier geologists. They looked upon them as freaks of Nature, whims of the creative energy, or vestiges of Noah's flood. You see they were blinded by the preconceived notions of the six-day theory of creation.

III

I do not know that the bird has taught me any valuable lesson. Indeed, I do not go to Nature to be taught. I go for enjoyment and companionship. I go to bathe in her as in a sea; I go to give my eyes and ears and all my senses a free, clean field and to tone up my spirits by her "primal sanities." If the bird has not preached to me, it has added to the resources of my life, it has widened the field of my interests, it has afforded me another beautiful object to love, and has helped make me feel more at home in this world. To take the birds out of my life would be like lopping off so many branches from the tree: there is so much less surface of leafage to absorb the sunlight and bring my spirits in contact with the vital currents. We cannot pursue any natural study with love and enthusiasm without the object of it becoming a part of our lives. The birds, the flowers, the trees, the rocks, all become linked with our lives and hold the key to our thoughts and emotions.

Not till the bird becomes a part of your life can

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its coming and its going mean much to you. And it becomes a part of your life when you have taken heed of it with interest and affection, when you have established associations with it, when it voices the spring or the summer to you, when it calls up the spirit of the woods or the fields or the shore. When year after year you have heard the veery in the beech and birch woods along the trout streams, or the wood thrush May after May in the groves where you have walked or sat, and the bobolink summer after summer in the home meadows, or the vesper sparrow in the upland pastures where you have loitered as a boy or mused as a man, these birds will really be woven into the texture of your life.

What lessons the birds have taught me I cannot recall; what a joy they have been to me I know well. In a new place, amid strange scenes, theirs are the voices and the faces of old friends. In Bermuda the bluebirds and the catbirds and the cardinals seemed to make American territory of it. Our birds had annexed the island despite the Britishers.

For many years I have in late April seen the red-poll warbler, perhaps for only a single day, flitting about as I walked or worked. It is usually my first warbler, and my associations with it are very pleasing. But I really did not know how pleasing until, one March day, when I was convalescing from a serious illness in one of our sea-coast towns, I chanced to spy the little traveler in a vacant lot

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along the street, now upon the ground, now upon a bush, nervous and hurried as usual, uttering its sharp chip, and showing the white in its tail. The sight gave me a real home feeling. It did me more good than the medicine I was taking. It instantly made a living link with many past springs. Anything that calls up a happy past, how it warms the present! There, too, that same day I saw my first meadowlark of the season in a vacant lot, flashing out the white quills in her tail, and walking over the turf in the old, erect, alert manner. The sight was as good as a letter from home, and better: it had a flavor of the wild and of my boyhood days on the old farm that no letter could ever have.

The spring birds always awaken a thrill wherever I am. The first bobolink I hear flying over northward and bursting out in song now and then, full of anticipation of those broad meadows where he will soon be with his mate; or the first swallow twittering joyously overhead, borne on a warm southern breeze; or the first high-hole sounding out his long, iterated call from the orchard or field — how all these things send a wave of emotion over me!

Pleasures of another kind are to find a new bird, and to see an old bird in a new place, as I did recently in the old sugar-bush where I used to help gather and boil sap as a boy. It was the logcock, or pileated woodpecker, a rare bird anywhere, and one I had never seen before on the old farm. I heard his loud cackle

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in a maple tree, saw him flit from branch to branch for a few moments, and then launch out and fly toward a distant wood. But he left an impression with me that I should be sorry to have missed.

Nature stimulates our æsthetic and our intellectual life and to a certain extent our religious emotions, but I fear we cannot find much support for our ethical system in the ways of wild Nature. I know our artist naturalist, Ernest Thompson Seton, claims to find what we may call the biological value of the Ten Commandments in the lives of the wild animals; but I cannot make his reasoning hold water, at least not much of it. Of course the Ten Commandments are not arbitrary laws. They are largely founded upon the needs of the social organism; but whether they have the same foundation in the needs of animal life apart from man, apart from the world of moral obligation, is another question. The animals are neither moral nor immoral: they are unmoral; their needs are all physical. It is true that the command against murder is pretty well kept by the higher animals. They rarely kill their own kind: hawks do not prey upon hawks, nor foxes prey upon foxes, nor weasels upon weasels; but lower down this does not hold. Trout eat trout, and pickerel eat pickerel, and among the insects young spiders eat one another, and the female spider eats her mate, if she can get him. There is but little, if any, neighborly love among even the higher animals. They

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treat one another as rivals, or associate for mutual protection. One cow will lick and comb another in the most affectionate manner, and the next moment savagely gore her. Hate and cruelty for the most part rule in the animal world. A few of the higher animals are monogamous, but by far the greater number of species are polygamous or promiscuous. There is no mating or pairing in the great bovine tribe, and none among the rodents that I know of, or among the bear family, or the cat family, or among the seals. When we come to the birds, we find mating, and occasional pairing for life, as with the ostrich and perhaps the eagle.

As for the rights of property among the animals, I do not see how we can know just how far those rights are respected among individuals of the same species. We know that bees will rob bees, and that ants will rob ants; but whether or not one chipmunk or one flying squirrel or one wood mouse will plunder the stores of another I do not know. Probably not, as the owner of such stores is usually on hand to protect them. Moreover, these provident little creatures all lay up stores in the autumn, before the season of scarcity sets in, and so have no need to plunder one another. In case the stores of one squirrel were destroyed by some means, and it were able to dispossess another of its hoard, would it not in that case be a survival of the fittest, and so conducive to the well-being of the race of squirrels?

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I have never known any of our wild birds to steal the nesting-material of another bird of the same kind, but I have known birds to try to carry off the material belonging to other species.

But usually the rule of might is the rule of right among the animals. As to most of the other commandments, — of coveting, of bearing false witness, of honoring the father and the mother, and so forth, — how can these apply to the animals or have any biological value to them? Parental obedience among them is not a very definite thing. There is neither obedience nor disobedience, because there are no commands. The alarm-cries of the parents are quickly understood by the young, and their actions imitated in the presence of danger, all of which of course has a biological value.

The instances which Mr. Seton cites of animals fleeing to man for protection from their enemies prove to my mind only how the greater fear drives out the lesser. The hotly pursued animal sees a possible cover in a group of men and horses or in an unoccupied house, and rushes there to hide. What else could the act mean? So a hunted deer or sheep will leap from a precipice which, under ordinary circumstances, it would avoid. So would a man. Fear makes bold in such cases.

I certainly have found "good in everything," — in all natural processes and products, — not the "good" of the Sunday-school books, but the good of

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natural law and order, the good of that system of things out of which we came and which is the source of our health and strength. It is good that fire should burn, even if it consumes your house; it is good that force should crush, even if it crushes you; it is good that rain should fall, even if it destroys your crops or floods your land. Plagues and pestilences attest the constancy of natural law. They set us to cleaning our streets and houses and to readjusting our relations to outward nature. Only in a live universe could disease and death prevail. Death is a phase of life, a redistributing of the type. Decay is another kind of growth.

Yes, good in everything, because law in everything, truth in everything, the sequence of cause and effect in everything, and it may all be good to me if on the right principles I relate my life to it. I can make the heat and the cold serve me, the winds and the floods, gravity and all the chemical and dynamical forces, serve me, if I take hold of them by the right handle. The bad in things arises from our abuse or misuse of them or from our wrong relations to them. A thing is good or bad according as it stands related to my constitution. We say the order of nature is rational; but is it not because our reason is the outcome of that order? Our well-being consists in learning it and in adjusting our lives to it. When we cross it or seek to contravene it, we are destroyed. But Nature in her universal procedures is not ra-

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tional, as I am rational when I weed my garden, prune my trees, select my seed or my stock, or arm myself with tools or weapons. In such matters I take a short cut to that which Nature reaches by a slow, roundabout, and wasteful process. How does she weed her garden? By the survival of the fittest. How does she select her breeding-stock? By the law of battle; the strongest rules. Hers, I repeat, is a slow and wasteful process. She fertilizes the soil by plowing in the crop. She cannot take a short cut. She assorts and arranges her goods by the law of the winds and the tides. She builds up with one hand and pulls down with the other. Man changes the conditions to suit the things. Nature changes the things to suit the conditions. She adapts the plant or the animal to its environment. She does not drain her marshes; she fills them up. Hers is the larger reason — the reason of the All. Man's reason introduces a new method; it cuts across, modifies, or abridges the order of Nature.

I do not see design in Nature in the old teleological sense; but I see everything working to its own proper end, and that end is foretold in the means. Things are not designed; things are begotten. It is as if the final plan of a man's house, after he had begun to build it, should be determined by the winds and the rains and the shape of the ground upon which it stands. The eye is begotten by those vibrations in the ether called light, the ear by those vibrations in

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the air called sound, the sense of smell by those emanations called odors. There are probably other vibrations and emanations that we have no senses for because our well-being does not demand them.

We think it reasonable that a stone should fall and that smoke should rise because we have never known either of them to do the contrary. We think it reasonable that fire should burn and that frost should freeze, because this accords with universal experience. Thus, there is a large order of facts that are reasonable because they are invariable: the same effect always follows the same cause. Our reason is developed and disciplined by observing the order of Nature; and yet human rationality is of another order from the rationality of Nature. Man learns from Nature how to master and control her. He turns her currents into new channels; he spurs her in directions of his own. Nature has no economic or scientific rationality. She progresses by the method of trial and error. Her advance is symbolized by that of the child learning to walk. She experiments endlessly. Evolution has worked all around the horizon. In feeling her way to man she has produced thousands of other forms of life. The globe is peopled as it is because the creative energy was blind and did not at once find the single straight road to man. Had the law of variation worked only in one direction, man might have found himself the sole occupant of the universe. Behold the varieties

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of trees, of shrubs, of grasses, of birds, of insects, because Nature does not work as man does, with an eye single to one particular end. She scatters, she sows her seed upon the wind, she commits her germs to the waves and the floods. Nature is indifferent to waste, because what goes out of one pocket goes into another. She is indifferent to failure, because failure on one line means success on some other.

IV

But I am not preaching much of a gospel, am I? Only the gospel of contentment, of appreciation, of heeding simple near-by things — a gospel the burden of which still is love, but love that goes hand in hand with understanding.

There is so much in Nature that is lovely and lovable, and so much that gives us pause. But here it is, and here we are, and we must make the most of it. If the ways of the Eternal as revealed in his works are past finding out, we must still unflinchingly face what our reason reveals to us. "Red in tooth and claw." Nature does not preach; she enforces, she executes. All her answers are yea, yea, or nay, nay. Of the virtues and beatitudes of which the gospel of Christ makes so much — meekness, forgiveness, self-denial, charity, love, holiness — she knows nothing. Put yourself in her way, and she crushes you; she burns you, freezes you, stings you, bites you, or devours you.

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Yet I would not say that the study of Nature did not favor meekness or sobriety or gentleness or forgiveness or charity, because the great Nature students and prophets, like Darwin, would rise up and confound me. Certainly it favors seriousness, truthfulness, and simplicity of life; or, are only the serious and single-minded drawn to the study of Nature? I doubt very much if it favors devoutness or holiness, as those qualities are inculcated by the church, or any form of religious enthusiasm. Devoutness and holiness come of an attitude toward the universe that is in many ways incompatible with that implied by the pursuit of natural science. The joy of the Nature student like Darwin or any great naturalist is to know, to find out the reason of things and the meaning of things, to trace the footsteps of the creative energy; while the religious devotee is intent only upon losing himself in infinite being. True, there have been devout naturalists and men of science; but their devoutness did not date from their Nature studies, but from their training, or from the times in which they lived. Theology and science, it must be said, will not mingle much better than oil and water, and your devout scientist and devout Nature student lives in two separate compartments of his being at different times. Intercourse with Nature—I mean intellectual intercourse, not merely the emotional intercourse of the sailor or explorer or farmer—tends to beget a habit

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of mind the farthest possible removed from the myth-making, the vision-seeing, the voice-hearing habit and temper. In all matters relating to the visible, concrete universe it substitutes broad daylight for twilight; it supplants fear with curiosity; it overthrows superstition with fact; it blights credulity with the frost of skepticism. I say frost of skepticism advisedly. Skepticism is a much more healthful and robust habit of mind than the limp, pale-blooded, non-resisting habit that we call credulity.

In intercourse with Nature you are dealing with things at first hand, and you get a rule, a standard, that serves you through life. You are dealing with primal sanities, primal honesties, primal attraction; you are touching at least the hem of the garment with which the infinite is clothed, and virtue goes out from it to you. It must be added that you are dealing with primal cruelty, primal blindness, primal wastefulness, also. Nature works with reference to no measure of time, no bounds of space, and no limits of material. Her economies are not our economies. She is prodigal, she is careless, she is indifferent; yet nothing is lost. What she lavishes with one hand, she gathers in with the other. She is blind, yet she hits the mark because she shoots in all directions. Her germs fill the air; the winds and the tides are her couriers. When you think you have defeated her, your triumph is hers; it is still by her laws that you reach your end.

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We make ready our garden in a season, and plant our seeds and hoe our crops by some sort of system. Can any one tell how many hundreds of millions of years Nature has been making ready her garden and planting her seeds?

There can be little doubt, I think, but that intercourse with Nature and a knowledge of her ways tends to simplicity of life. We come more and more to see through the follies and vanities of the world and to appreciate the real values. We load ourselves up with so many false burdens, our complex civilization breeds in us so many false or artificial wants, that we become separated from the real sources of our strength and health as by a gulf.

For my part, as I grow older I am more and more inclined to reduce my baggage, to lop off superfluities. I become more and more in love with simple things and simple folk — a small house, a hut in the woods, a tent on the shore. The show and splendor of great houses, elaborate furnishings, stately halls, oppress me, impose upon me. They fix the attention upon false values, they set up a false standard of beauty; they stand between me and the real feeders of character and thought. A man needs a good roof over his head winter and summer, and a good chimney and a big wood-pile in winter. The more open his four walls are, the more fresh air he will get, and the longer he will live.

How the contemplation of Nature as a whole does

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take the conceit out of us! How we dwindle to mere specks and our little lives to the span of a moment in the presence of the cosmic bodies and the interstellar spaces! How we hurry! How we husband our time! A year, a month, a day, an hour may mean so much to us. Behold the infinite leisure of Nature!

A few trillions or quadrillions of years, what matters it to the Eternal? Jupiter and Saturn must be billions of years older than the earth. They are evidently yet passing through that condition of cloud and vapor and heat that the earth passed through untold æons ago, and they will not reach the stage of life till æons to come. But what matters it? Only man hurries. Only the Eternal has infinite time. When life comes to Jupiter, the earth will doubtless long have been a dead world. It may continue a dead world for æons longer before it is melted up in the eternal crucible and recast, and set on its career of life again.

Familiarity with the ways of the Eternal as they are revealed in the physical universe certainly tends to keep a man sane and sober and safeguards him against the vagaries and half-truths which our creeds and indoor artificial lives tend to breed. Shut away from Nature, or only studying her through religious fears and superstitions, what a mess a large body of mankind in all ages have made of it! Think of the obsession of the speedy "end of the world" which

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has so often taken possession of whole communities, as if a world that has been an eternity in forming could end in a day, or on the striking of the clock! It is not many years since a college professor published a book figuring out, from some old historical documents and predictions, just the year in which the great mundane show would break up. When I was a small boy at school in the early forties, during the Millerite excitement about the approaching end of all mundane things, I remember, on the day when the momentous event was expected to take place, how the larger school-girls were thrown into a great state of alarm and agitation by a thunder-cloud that let down a curtain of rain, blotting out the mountain on the opposite side of the valley. "There it comes!" they said, and their tears flowed copiously. I remember that I did not share their fears, but watched the cloud, curious as to what the end of the world would be like. I cannot brag, as Thoreau did, when he said he would not go around the corner to see the world blow up. I am quite sure my curiosity would get the better of me and that I should go, even at this late day. Or think of the more harmless obsession of many good people about the second coming of Christ, or about the resurrection of the physical body when the last trumpet shall sound. A little natural knowledge ought to be fatal to all such notions. Natural knowledge shows us how transient and insignificant we are, and how

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tuitous and unrelated, but have their root in the constitution of things. There is nothing on or in the earth that is not of the earth; it is all latent or patent in the cosmic process.

II

Strange how men have speculated about the origin of evil, and built themselves cages in which to bruise their own wings. Evil has been regarded as something as positive as light, or heat, or any tangible object. Our moral and religious nature has so regarded it, but the reason sees that evil is only the shadow of good, and is as inevitable as good is inevitable. Life has its positive and its negative sides. Its positive side is health and growth and enjoyment, its negative side is disease and decay and suffering. All that favors the former is good, all that leads to the latter is bad, relatively bad. Disease is only another form of life. The germs that are pulling us down and destroying us in typhoid fever or cholera are healthy and thriving if we are not. What is good for them is bad for us. Life preys upon life everywhere, and the devoured is the victim of evil. We live and move and have our being submerged in an ocean of germs, myriads of them for us and myriads of them against us on occasion; one kind building up, another kind pulling down, and, as it were, redistributing the type. Life as we know it could not go on without both

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kinds. Without the germs of fermentation, for instance, what would happen to the world? Without the germs that break down animal and vegetable tissue and redistribute the elements of which they are composed — the germs of death — how long could life go on?

A fever tortures and burns my flesh because the body fights against the germs that would destroy it. It is one form of life struggling with another form. A festering pool in the fields or woods conceals chemical processes that all favor life.

Life is the result of a certain balance between what we call good and evil forces. Destroy that balance, that harmonious adjustment, and death or disease follows. We imperil it when we eat too much, or drink too much, or work too hard, or sleep too little, or exclude the air and sunlight from our houses. A pestilence is just as much an evidence of the health and soundness of nature as is immunity from it, only it is the health of forces that for reasons antagonize our health. We have let the enemy encamp and intrench in our midst while we slumbered. If we had life on easier terms than eternal vigilance, what would it be worth? If we want to escape blow-flies and mosquitoes and the contagion of this or that, let us go to the Arctic or Antarctic regions, where death reigns perpetual.

Struggle is the condition of evolution, and evolution is the road all life has traveled. Moral evil

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served ways of the Eternal, if these bodies had had worlds in their train, teeming with life, which met the same fate as the central colliding bodies.

Does not force as we know it in this world go its own way with the same disregard of the precious thing we call life? Such long and patient preparations for it, — apparently the whole stellar system in labor pains to bring it forth, — and yet held so cheaply and indifferently in the end! The small insect that just now alighted in front of my jack-plane as I was dressing a timber, and was reduced to a faint yellow stain upon the wood, is typical of the fate of man before the unregarding and unswerving terrestrial and celestial forces. The great wheels go round just the same whether they are crushing the man or crushing the corn for his bread. It is all one to the Eternal. Flood, fire, wind, gravity, are for us or against us indifferently. And yet the earth is here, garlanded with the seasons and riding in the celestial currents like a ship in calm summer seas, and man is here with all things under his feet. All is well in our corner of the universe. The great mill has made meal of our grist and not of the miller. We have taken our chances and have won. More has been for us than against us. During the little segment of time that man has been upon the earth, only one great calamity that might be called cosmic has befallen it. The ice age of one or two hundred thousand years was such a calamity. But man

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survived it. The spring came again, and life, the traveler, picked itself up and made a new start. But if he had not survived it, if nothing had survived it, the great procession would have gone on just the same; the gods would have been just as well pleased.

The battle is to the strong, the race is to the fleet. This is the order of nature. No matter for the rest, for the weak, the slow, the unlucky, so that the fight is won, so that the race of man continues. You and I may fail and fall before our time; the end may be a tragedy or a comedy. What matters it? Only some one must succeed, will succeed.

We are here, I say, because, in the conflict of forces, the influences that made for life have been in the ascendant. This conflict of forces has been a part of the process of our development. We have been ground out as between an upper and a nether millstone, but we have squeezed through, we have actually arrived, and are all the better for the grinding — all those who have survived. But, alas for those whose lives went out in the crush! Maybe they often broke the force of the blow for us.

Nature is not benevolent; Nature is just, gives pound for pound, measure for measure, makes no exceptions, never tempers her decrees with mercy, or winks at any infringement of her laws. And in the end is not this best? Could the universe be run as a charity or a benevolent institution, or as a poor-

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house of the most approved pattern? Without this merciless justice, this irrefragable law, where should we have brought up long ago? It is a hard gospel; but rocks are hard too, yet they form the foundations of the hills.

Man introduces benevolence, mercy, altruism, into the world, and he pays the price in his added burdens; and he reaps his reward in the vast social and civic organizations that were impossible without these things.

I have no doubt that the life of man upon this planet will end, as all other forms of life will end. But the potential man will continue and does continue on other spheres. One cannot think of one part of the universe as producing man, and no other part as capable of it. The universe is all of a piece so far as its material constituents are concerned; that we know. Can there be any doubt that it is all of a piece so far as its invisible and intangible forces and capabilities are concerned? Can we believe that the earth is an alien and a stranger in the universe? that it has no near kin? that there is no tie of blood, so to speak, between it and the other planets and systems? Are the planets not all of one family, sitting around the same central source of warmth and life? And is not our system a member of a still larger family or tribe, and it of a still larger, all bound together by ties of consanguinity? Size is nothing, space is nothing. The worlds are only

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red corpuscles in the arteries of the infinite. If man has not yet appeared on the other planets, he will in time appear, and when he has disappeared from this globe, he will still continue elsewhere.

I do not say that he is the end and aim of creation; it would be logical, I think, to expect a still higher form. Man has been man but a little while comparatively, less than one hour of the twenty-four of the vast geologic day; a few hours more and he will be gone; less than another geologic day like the past, and no doubt all life from the earth will be gone. What then? The game will be played over and over again in other worlds, without approaching any nearer the final end than we are now. There is no final end, as there was no absolute beginning, and can be none with the infinite.

THE END

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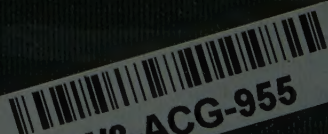
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